PETROLEUM REFINER

THEY GET THE REFINERY VOTE

SIXTY-FOUR Elliott type YR Mechanical Drive Turbines serve a new cat cracker in this Mid-west refinery. The three illustrated below drive hot oil pumps . . . These are the turbines that without sacrifice of standardization can be adapted to any conditions. Refineries are strong for them. Why not investigate?

ELLIOTT COMPANY
STEAM TURBINE DEPT., JEANNETTE, PA.
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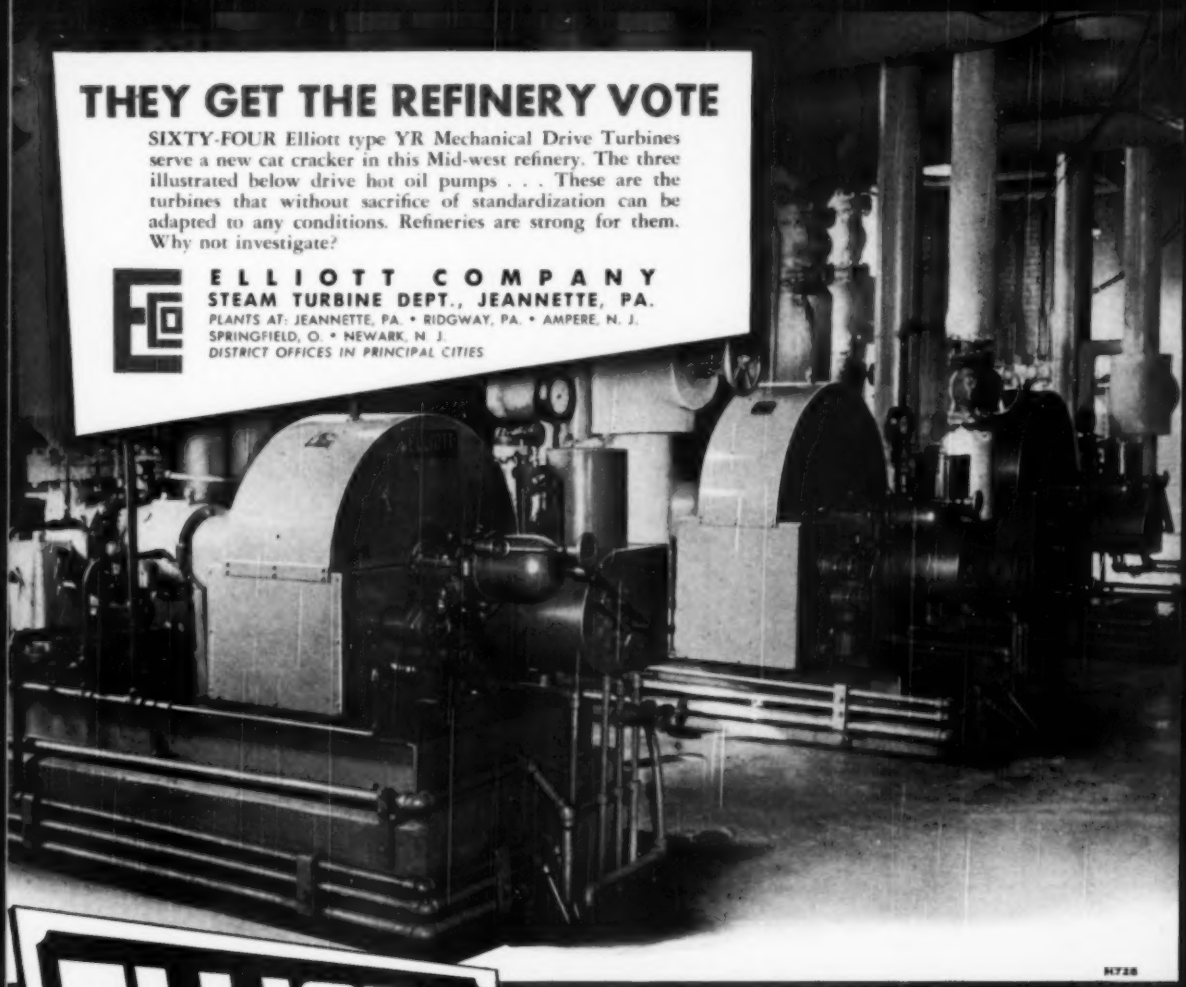


H728

ELLIOTT

MECHANICAL DRIVE TURBINES for refineries

"HOTTER, SOONER"

Saves

YOU MONEY

Yarway Impulse Steam Trap with new stainless steel body.

Yarway Impulse Steam Traps get equipment hot and into production *faster*. Extra profits!

Then they keep it *continuously* at peak operating temperatures for maximum production. More extra profits!

What's the reason for *hotter, sooner?* Just this. When steam is turned on, Yarways open wide, discharging the air and condensate *in a hurry* —closing only when steam arrives. Then, when operating temperature has been quickly reached, the little valve (only moving part) literally *floats on the load* . . . discharging heat-retarding condensate as soon as it forms instead of waiting for quantities to accumulate. Thus equipment is held at peak operating efficiency.

Other economical features of Yarway traps—minimum maintenance, easy installation, low initial cost.

More than 600,000 Yarways have already been installed. Sold by distributors throughout the world.

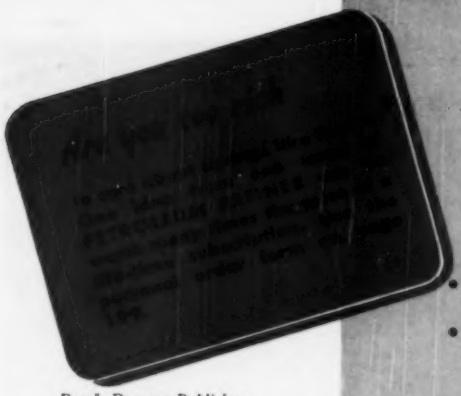
Try a Yarway today . . . standardize on Yarways tomorrow.

YARNALL-WARING COMPANY
128 MERMAID AVENUE, PHILA. 18, PA.

Nest of Yarway traps installed with Yarway Strainers on cloth dryer. Note small space required.

Stainless Steel Body

YARWAY IMPULSE STEAM TRAP



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PETROLEUM REFINER and The REFINERY CATALOG
for the refining-natural gasoline industry

WORLD OIL (formerly The Oil Weekly)
and The COMPOSITE CATALOG
for the drilling-producing-pipe line industry

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PETROLEUM REFINER

Specialized for Refining, Natural Gasoline and Petrochemical Engineering, Operation and Management

R. L. DUDLEY, President — A. L. BURNS, General Manager

VOLUME 29, No. 6 — JUNE, 1950

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SAVE HALF THE COST

True, this oxygen plant high-pressure tower of Alcoa Aluminum represents a healthy chunk of cash. But made of any other suitable metal it would cost 25 to 50% more. That's how Alcoa Aluminum makes substantial savings in exchangers, vessels, towers and piping for subzero processes.

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For more information, mail the attached coupon to: ALUMINUM COMPANY OF AMERICA, 1476F Gulf Bldg., Pittsburgh 19, Pennsylvania.

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Please send more information on aluminum's properties and applications for subzero process equipment.

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"Shop PSC Firrt" may remind you of the slogan of one of your local department stores. Actually there is a real resemblance between the two institutions in one characteristic:— Wide Selection. The Pressed Steel Co. offers you the largest choice of standard styles of bubble caps and risers available: 200 of the most commonly specified styles. As a result PSC not only makes prompt delivery, but we also save you the cost of dies. Caps to meet special needs will be promptly designed.

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BUBBLE CAP BULLETIN 21
We believe it is the largest compilation of engineering data on bubble caps and risers in printed form. Also contains drawings for use in determining methods of tray assembly.

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Industrial Equipment of Heat and Corrosion Resistant WEIGHT-SAVING *Sheet Alloys*

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Looking for the answer to tube failures? Ask the experts!

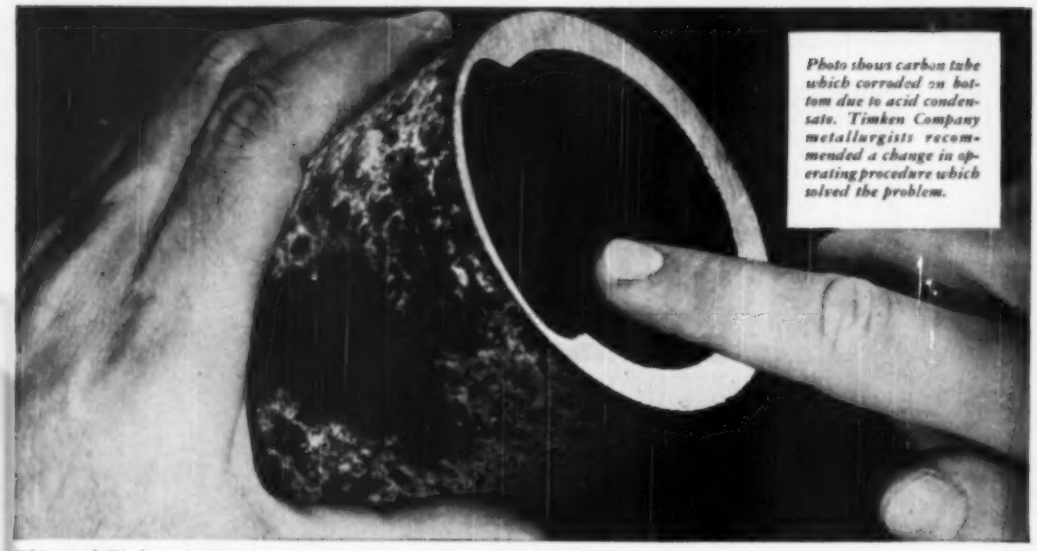


Photo shows carbon tube which corroded on bottom due to acid condensate. Timken Company metallurgists recommended a change in operating procedure which solved the problem.

This month Timken reports on:

DM STEEL

Has unusually high creep strength for a pearlitic steel, good stability up to 1200°F., fairly good corrosion and oxidation resistance. Has 2 to 3 times the life of carbon steel where corrosion is not severe. Recommended for cracking furnace tubes, hot oil lines, superheater tubes, high temperature steam piping and forgings for accessory parts.

ONE OF 23 TIMKEN HIGH TEMPERATURE STEELS

Carbon	Sicromo 2	Sicromo 9S	16-13-3*
Carbon-Mo.	Sicromo 2¼	Sicromo 5MS	25-20*
DM-2	2¼% Cr.-1% Mo.	Sicromo 7	25-12*
Silmo	Sicromo 3	Sicromo 9M	35-15*
DM	4-6% Cr.-Mo.	18-8 stainless	16-25-6*
2% Cr.-Mo.	4-6% Cr.-Mo.-Ti.	18-8 Cb	

**Available as seamless tubing on an experimental basis only.*

BY analyzing tube failures like the one above, Timken® Company metallurgists have helped dozens of refineries make important savings in tube costs.

Still more refineries have saved by our metallurgists' ability to recommend the *one* steel that can give them the best life/cost ratio.

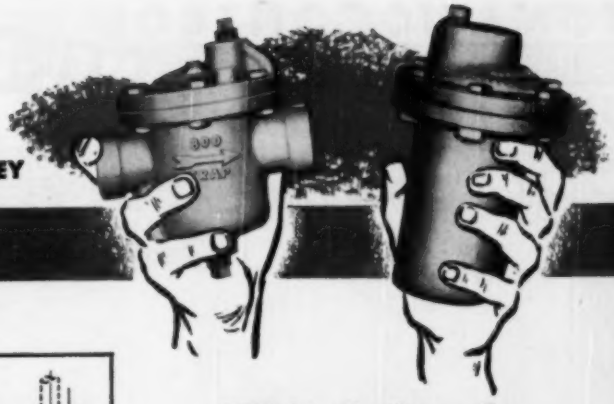
Timken Company metallurgists are acknowledged experts in high temperature steels—backed by over 21 years of leading research and the widest field experience. They have the greatest range of steels—23 analyses—to select from. Quality of the tubes they supply is assured by Timken's complete control of manufacture—from melting through final inspection.

Let Timken's "TSQ"—Research, Supply, Quality—solve your high temperature tube problems. Ask the experts! The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

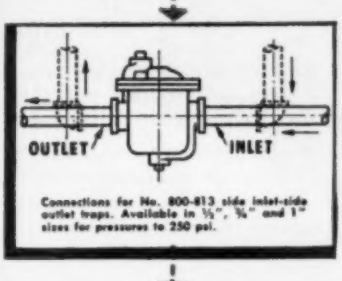
YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH

Specialists in alloy steel—including hot rolled and cold finished alloy steel bars—a complete range of stainless, graphitic and standard tool analyses—and alloy and stainless seamless steel tubing

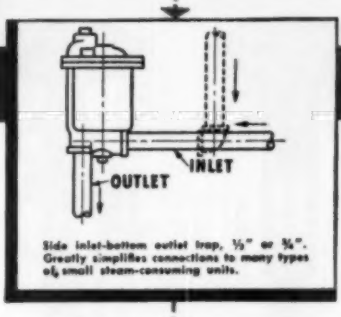
YOU SAVE TIME AND MONEY



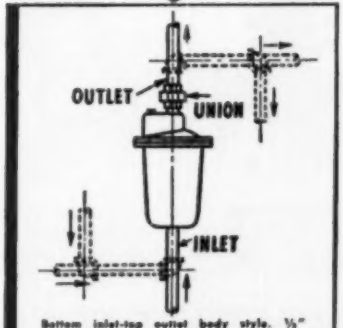
"This choice of Steam Trap Body Styles simplifies installations"



Connections for No. 800-813 side inlet-side outlet traps. Available in ⅛", ¼" and 1" sizes for pressures to 250 psi.



Side inlet-bottom outlet trap, ⅛" or ¼". Greatly simplifies connections to many types of small steam-consuming units.



Bottom inlet-top outlet body style. ⅛" through 2" connections. Cast semi-steel bodies for pressures to 250 psi. Forged steel bodies for pressures to 1500 psi.

IN THE most widely used sizes, Armstrong Steam Traps are available in either side inlet-side outlet or bottom inlet-top outlet body styles. This gives the user an opportunity to make exceptionally neat installations with a minimum of fittings and a minimum of labor and permits correct location of the trap in relation to the unit being drained.

In both styles the entire interior mechanism may be taken out for inspection or repair simply by removing the cap. The body, full of boiling water, is left in the line. In the case of the side inlet trap the cap may be removed without even disturbing the pipe connections.

Ask your nearby Armstrong representative to show you the opportunities for simplifying trap installations.

ARMSTRONG MACHINE WORKS
852 Maple St., Three Rivers, Mich.

THE 36-PAGE ARMSTRONG STEAM TRAP BOOK gives data and prices on the complete line of Armstrong steam traps for every pressure, every application. This book is a valuable reference for the calculation of condensate loads and the selection of traps for all classes of equipment. Send for free copy today

ARMSTRONG STEAM TRAPS

AUTOMATIC CONTROL EQUIPMENT

ENGINEERED DESIGN BY **HAMMEL-DAHL**

CONTROL VALVES for every Process Application

There is a FLO-TESTED Hammel-Dahl Control Valve that will meet the exact requirements of every Process Control Application.

Engineered design for a maximum working pressure of 15,000 PSI and temperatures from —300° F. to 1200°F.

Size range from ½" thru 12" (C_V: 0.001 — 1440) will accurately control extremes in flow, temperature and pressure on air, water, steam, oil or gas service.

3000 SERIES
CONTROL VALVE
Sizes ½" — 12" (Cv: 1-1440)
Body — CI., Steel or Sts.
MWP 1500# ASA Std.

7000 SERIES
MICROFLO CONTROL VALVE
Sizes ½" — 3/4" (Cv: 0.001-0.63)
Body — Steel or Stainless Steel
MWP 15000# @ 100°F.

7000A SERIES
VENTURIFLO CONTROL VALVE
Sizes 1" — 8" (Cv: 1-860)
Body — Steel or Stainless Steel
MWP 1500# ASA Std.

7000AB SERIES
VENTURIFLO CONTROL VALVE
Sizes ½" — 8" (Cv: 1-860)
Bellows — 347 Stainless Steel
MWP 3000# @ 750°F.

3000BX SERIES
ALLOY CONTROL VALVE
Sizes ½" — 10" (Cv: 1-1080)
BODY — Any Castable Alloy
MWP 3000# ASA Std.

7000MP SERIES
VENTURIFLO CONTROL VALVE
Sizes 1" — 8" (Cv: 1-860)
Body — Steel or Stainless Steel
MWP 1500# ASA Std.

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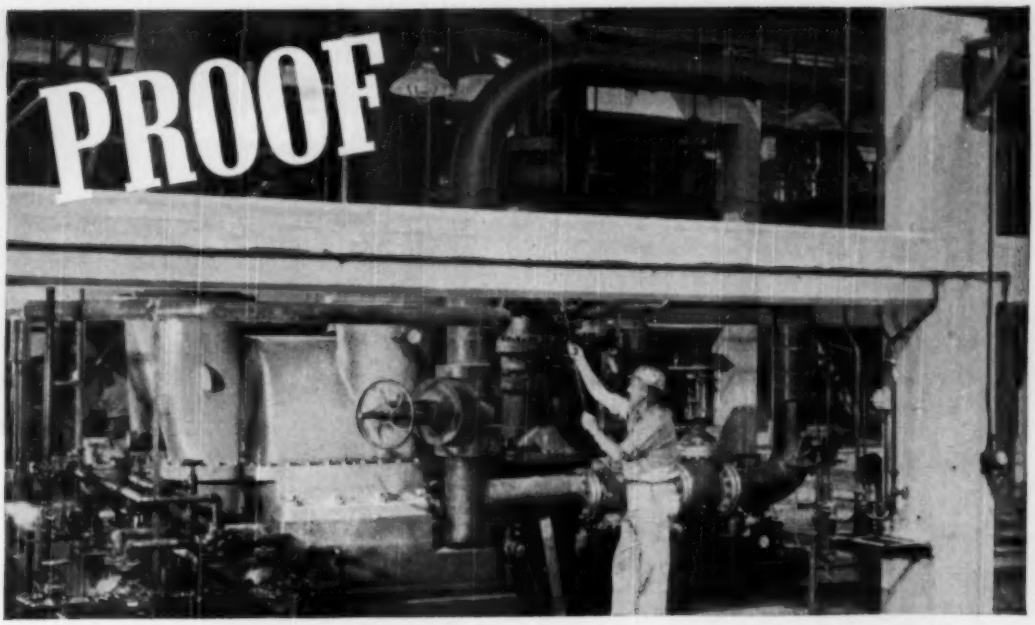
In Canada: Railway & Power Engineering Corporation, Ltd



...is in Performance!

AT CITIES SERVICE REFINERY, ALLIS-CHALMERS CENTRIFUGAL BLOWERS TURN 85 TIMES A SECOND FOR 1½ YEARS!

IN AN "AROUND THE CLOCK" fluid catalytic cracking plant, equipment reliability is *vital*. Cities Service, Lake Charles, La. depends on seven Allis-Chalmers centrifugal blowers for catalyst aeration. They're rated 22,500 cfm, 17 lb G at 5100 rpm.

Six of the seven were installed in 1943. Two proceeded to set a record of 540 days, 24 hrs a day, continuous operation; being shut down only for drive inspection! Two others ran for 562 days before scheduled inspection shutdown! Only routine maintenance has been required on all seven to date.

These blowers are still on the job, 24 hrs a day, helping produce motor, premium and aviation gasoline for the widespread operations of Cities Service. Output is at constant volume, automatically maintained by variable speed 2200 hp steam turbine drives.

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PURE ROTARY MOTION — precisely balanced impeller is only moving part.

FRICTION FREE INTERIOR — bearings outside casing, no internal mechanical wear.

SIMPLE LUBRICATION — oil under pressure in closed circuit, consumption low.

STRONG CONSTRUCTION — forged steel shaft, alloy steel high speed impeller reduces unit size, weight.

CAST IRON CASING — makes blower rigid, smooth, quiet.

THOROUGH TESTING — impeller given severe over-speed test, blower factory tested at maximum speed.

For this kind of highly dependable, low maintenance air and gas handling equipment, call your nearest A-C office or write direct for literature.

ALLIS-CHALMERS, 1062A SO. 70 ST. MILWAUKEE, WIS. A-3030

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ALLIS-CHALMERS

Power, Electrical, Processing Equipment for Petroleum Industry

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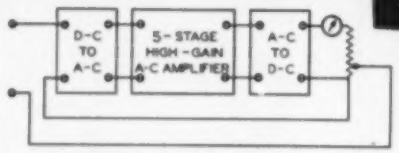
For low-level d-c measurements Use these new, triple-purpose D-C INDICATING AMPLIFIERS

stabilized for zero and gain



Voltage-balance feedback (above) and current-balance feedback stabilize gain . . . provide virtual null balance.

SPECIFICATIONS

	MICROVOLT UNIT	MICRO-MICRO-AMPERE UNIT
	Catalog No. 9835	Catalog No. 9836
FULL SCALE RANGES WITH BUILT-IN 4" METERS	0 to 50 or —25 to +25 Microvolts; scale multipliers: 1,2,4,10, 20,40	0 to 1000 or —500 to +500 Micro-Micro-amps; scale multipliers: 1, 2, 5, 10, 20, 50, 100, 200, 500, 1000, 2000
ACCURACY	Of amplifier: ±0.4% of reading ±0.5 Microvolt; Of meter: ±1%	Of amplifier: ±0.5 to 0.8%* of reading ±20 Micro-Micro-amps; Of meter, ±1%
STABILITY	Zero and Gain stabilized automatically. No trimmer controls required.	
*SOURCE RESISTANCE	Up to 10,000 ohms.	0.1 megohm or more.
RESPONSE TIME	2 to 3" sec.	2 to 3" sec.

OUTPUT

For full scale input on any range: 10 millivolts at output impedance of 500 ohms for null recorder; 1 volt for 20,000-ohm external meter.

Front panel fits standard 19" relay rack.

*Accuracy and Response Time depend on Source Resistance.

USE AS

- **DIRECT-READING MICROVOLTMETER OR MICRO-MICROAMMETER**
- **RECORDER PREAMPLIFIER**
- **NULL DETECTOR**

These new instruments are not only D-C Indicating Amplifiers but are stable, accurate measuring instruments as well. You can use them in measurements with thermocouples, strain gages, bolometers . . . bridge and potentiometer circuits . . . ionization, leakage, and phototube currents . . . almost any measurement of extremely small direct current or voltage.

Through a combination of a-c amplification and unique balanced feedback network, zero and gain stability are designed right into the instrument. Trimmer controls are designed out—eliminated.

Actually *three* instruments in one, these amplifiers can be used as—

Direct-reading instruments . . . At the turn of a scale-multiplier knob, you simply select the range in which you want to work.

Recorder preamplifiers . . . with broad flexibility. For instance, one or two degrees of temperature difference can be spread across an entire Speedomax recorder scale.

Null detectors . . . more sensitive than most reflecting galvanometers, yet with full scale response time of only 2 to 3 seconds. Leveling is unnecessary. There's no worry about shock or vibration. At the turn of a range knob, you have available a wide choice of sensitivities. External shunts are not required. And when using non-linear response, not only does the instrument stay on scale at extreme unbalance; sensitivity increases automatically as the null point is approached. For details, write to Leeds & Northrup Co., 4923 Stenton Ave., Phila. 44, Pa.

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LEEDS & NORTHRUP CO.

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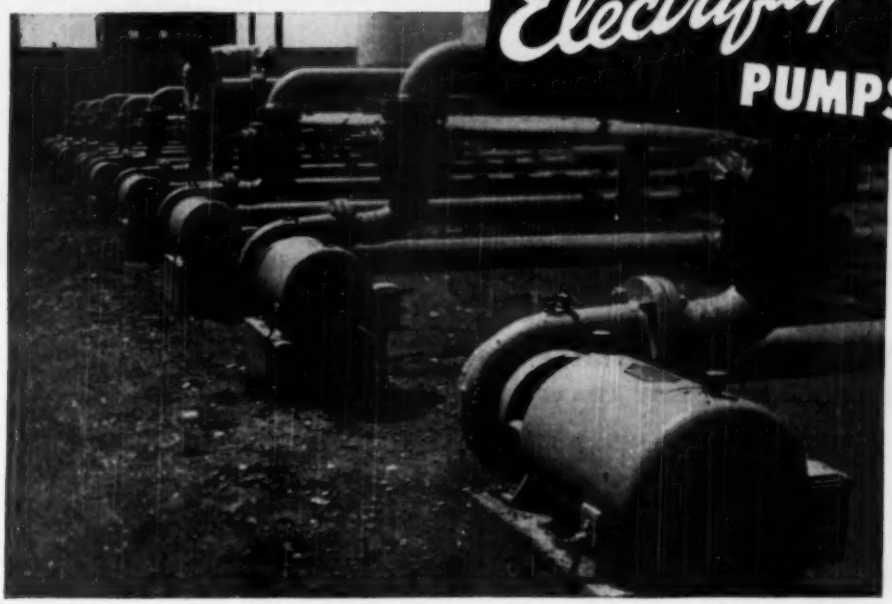
Cut Petroleum Pumping Costs With *Electrifugal* PUMPS



1 SAVE ON INSTALLATION! *Electrifugal* pump comes ready to connect and run. No extra parts. Easy to handle. Requires small installation space.

2 SAVE ON OPERATION! Pump and motor designed together for high efficiency. Every unit tested at factory and guaranteed to deliver rated capacity.

3 SAVE ON MAINTENANCE! Motor and pump have single shaft — assuring perfect and permanent alignment. Parts easily accessible. Has fewer parts and machined fits.

Electrifugal and *Texrope* are Allis-Chalmers trademarks.

OVER 42,000,000 GALLONS OF PETROLEUM PRODUCTS are pumped annually through 15 Allis-Chalmers close-coupled pumps at this new midwest bulk station.

Distribution failures are avoided through the dependable service of these "one-package" pump-motor units. Bronze wearing ring protects casing from wear and is easily replaced when required.

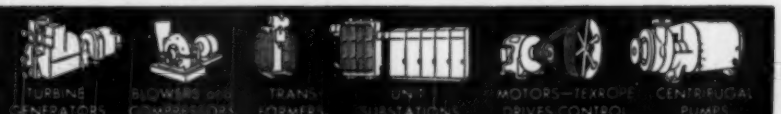
Electrifugal pumps range from 10 to 1600 gpm with heads to 525 ft. For information, see your Allis-Chalmers Authorized Dealer or Sales Office. Or write for Bulletin 52B6059E. A-2974

ALLIS-CHALMERS, 1062A SO. 70 ST.
MILWAUKEE, WIS.

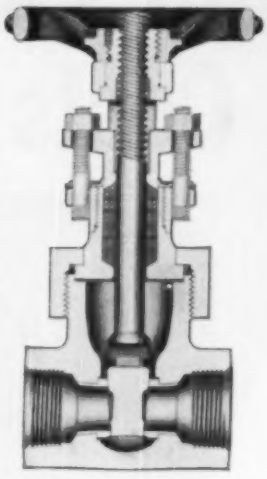
A-C ALLIS-CHALMERS

ALLIS-CHALMERS

Power, Electrical, Processing Equipment for Petroleum Industry



All the piping equipment you need ...on one order to CRANE



No. 3602X or XW
Sizes: ¼ to 2-inch
Screwed or welding ends

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Crane 600-Pound Small Steel Gates with Union Bonnet—for oil and oil vapor services—are smaller, lighter, and more compact than usual high pressure design. High quality carbon steel body, bonnet, and yoke provide extra strength and safety under rough usage and extreme pressure-temperature conditions.

Seating can be either Crane Exelloy to Exelloy, or Crane Hardened Stainless Steel to Exelloy. Seat rings of heavy section, securely rolled into body, prevent leakage around the ring . . . will not loosen in service. Husky bonnet ring, with long, precision cut threads, pulls up easily—always stays tight. Blowout-proof, soft iron gasket in bonnet joint is unaffected by highest temperatures or fluids on recommended services. For more information, see your Crane No. 49 Catalog or write for Circular AD-1741.

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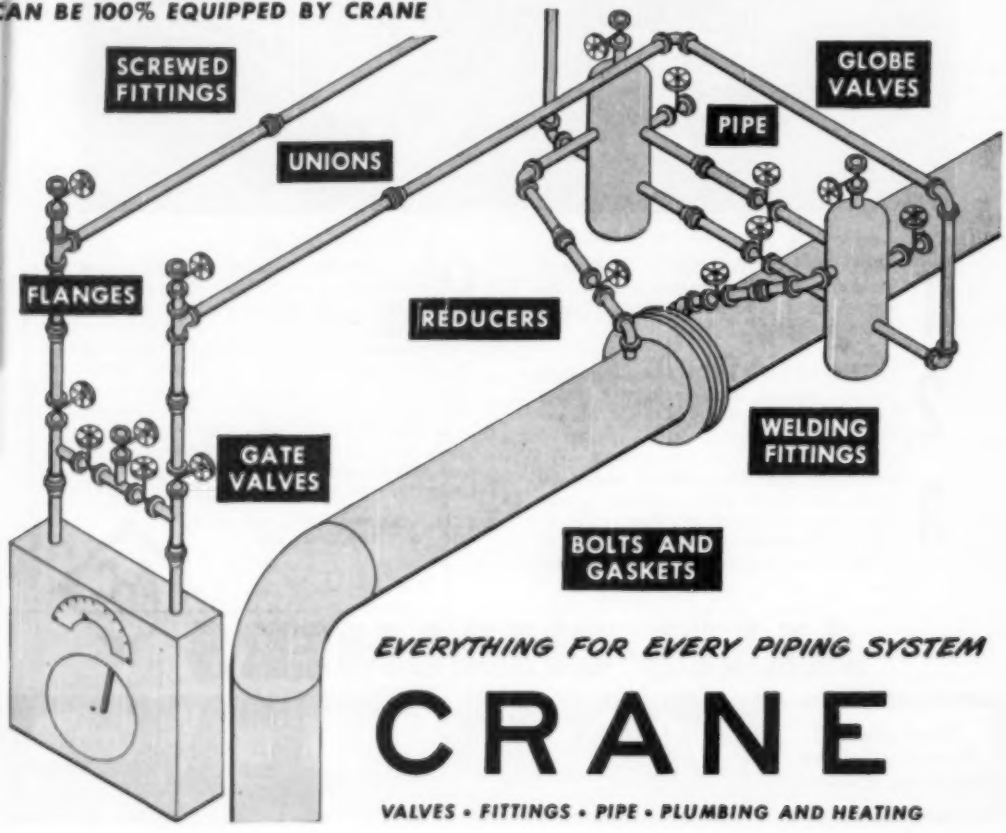
Branches and Wholesalers Serving All Industrial Areas

THIS METER PIPING INSTALLATION, FOR EXAMPLE, CAN BE 100% EQUIPPED BY CRANE



EVERYTHING FOR EVERY PIPING SYSTEM

CRANE

VALVES • FITTINGS • PIPE • PLUMBING AND HEATING

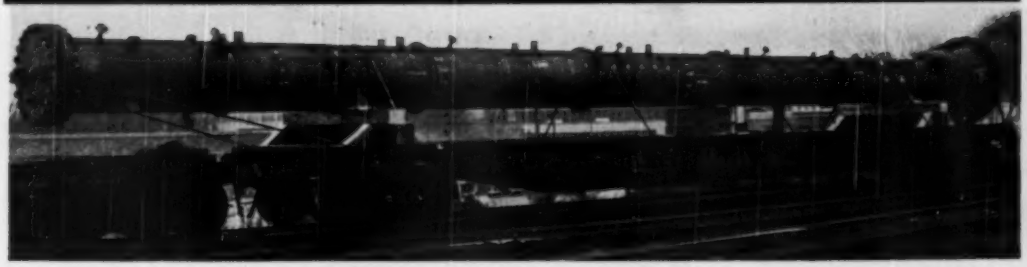
VESSEL DIVISION

NEWS

76th ANNIVERSARY 1874 - 1950

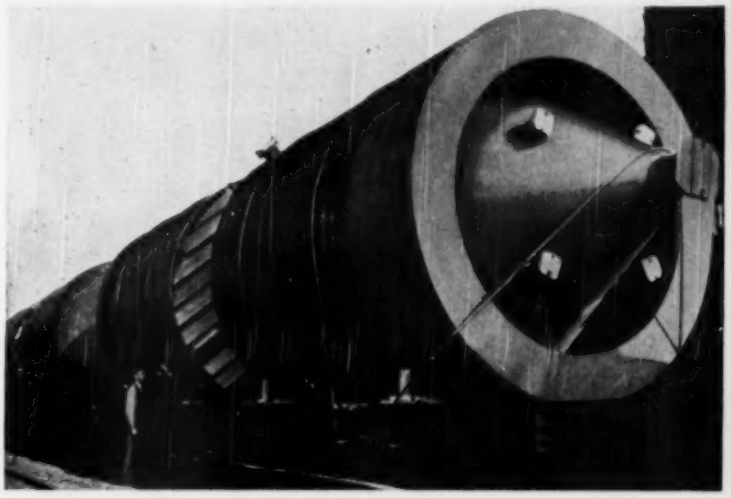
A.O.Smith CORPORATION

Atlanta 3 • Boston 16 • Chicago 4 • Dallas 1 • Houston 2
Los Angeles 14 • New York 17 • Philadelphia 3 • Pittsburgh 19
Salt Lake City 1 • Seattle 1 • Tulsa 3 • Washington 6, D.C.
International Division: Milwaukee 1

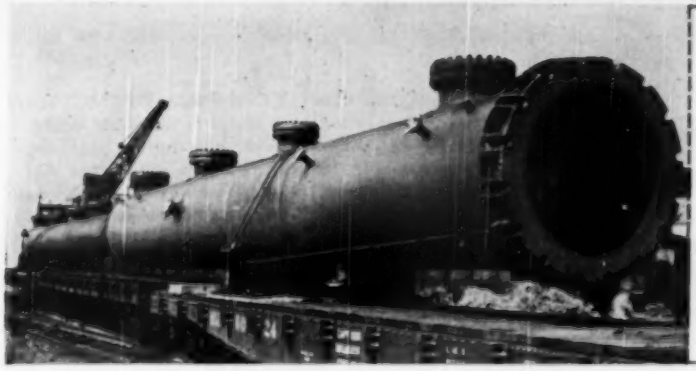


INTO EVERY SMITHlined FAT-SPLITTING TOWER, like the above 68-ft.-long SMITHway Tower, goes the experience and knowledge gained from a long and extensive program of research and development into the corrosion problems of the Fatty Acid Industry.

THREADING A NEEDLE. Getting a 12 ft. dia. by 43 ft. long paper mill replacement digester into an existing building is a difficult feat. A. O. Smith did it by shipping the SMITHlined Digesters *in sections* for final assembly and welding in place inside the paper mill.



A. O. SMITH MAKES ALL TYPES OF OIL-REFINING PRESSURE VESSELS. Here is one type, a SMITHlined Absorber Tower three railroad cars long (approximately 107 ft. long), leaving for a refinery in Ohio.



A. O. Smith Corporation, Dept. PR-650
Milwaukee 1, Wisconsin

Without obligation, send us the latest A. O. Smith Vessel Bulletins:

- ☐ V-44: Field Assembly of Pressure Vessels
- ☐ V-46: Alloy, Alloy-lined, Clad, and Glass-lined Vessels
- ☐ V-52: Multi-Layer Vessel Manufacture and Assembly

Name _____

Firm _____

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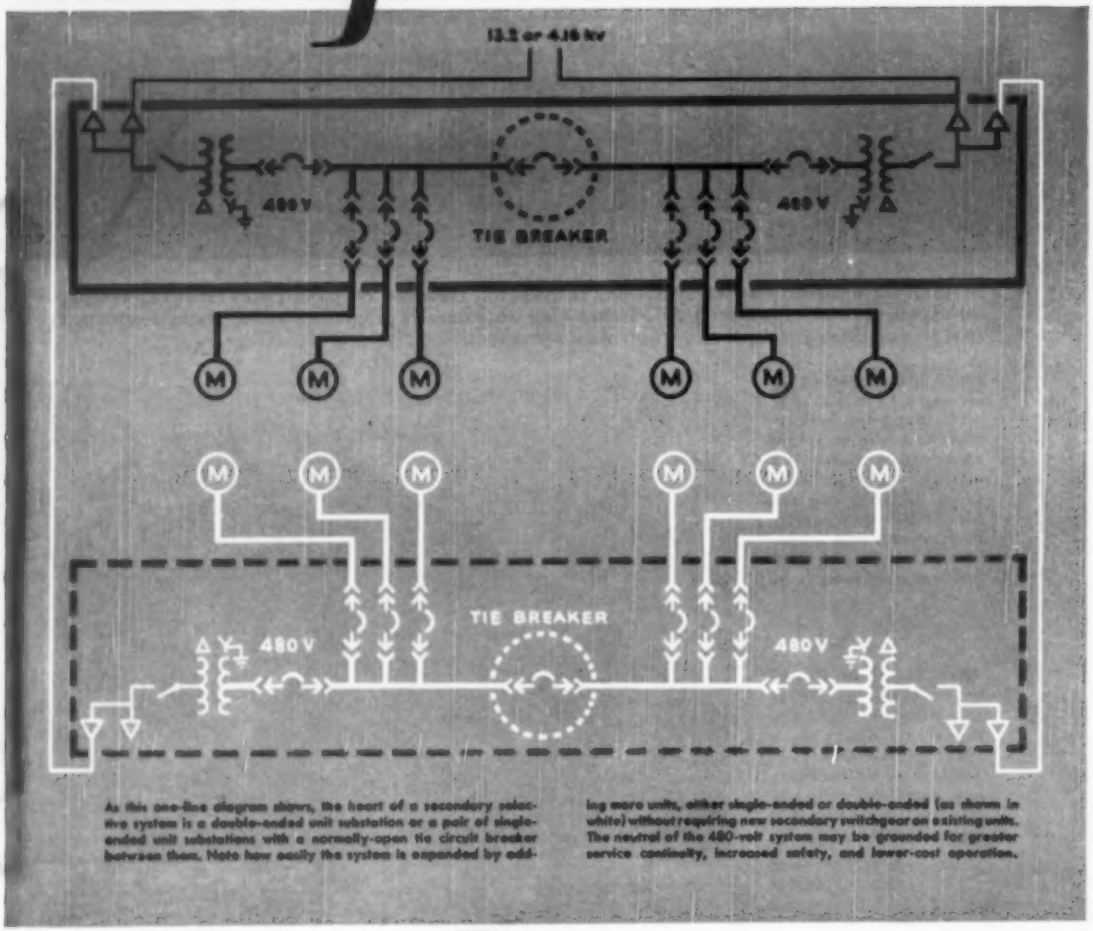
City _____ State _____

What's the trend in refinery electrification? } *secondary*



As this one-line diagram shows, the heart of a secondary selective system is a double-ended unit substation or a pair of single-ended unit substations with a normally-open tie circuit breaker between them. Note how easily the system is expanded by adding more units, either single-ended or double-ended (as shown in white) without requiring new secondary switchgear on existing units. The neutral of the 480-volt system may be grounded for greater service continuity, increased safety, and lower-cost operation.

Here's what you need to modernize your power system! }

WHEN YOU COME TO GENERAL ELECTRIC you get far more than the finest in electrical equipment. A General Electric application engineer, familiar with refinery practices, is at your disposal. If desired, he stands ready to assist you in co-ordinating all the needed components, engineering your power distribution into one modern, efficient system.

selective distribution systems

WITH UNIT SUBSTATIONS

—to protect continuity of service at minimum cost

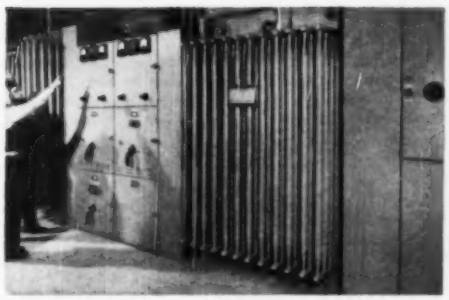
What's behind the growing refinery practice of distributing power through secondary selective systems? Primarily it's recognition of the fact that for most plants it provides a simple, low-cost way to safeguard service continuity for operations requiring uninterrupted production.

This method utilizes a normally-open tie circuit breaker between the secondaries of two transformers in a double-ended unit substation. The tie provides an alternate source of power for secondary circuits if either transformer becomes de-energized by a fault in the primary circuit. In effect, it enables one "partner" when necessary to carry the essential load.

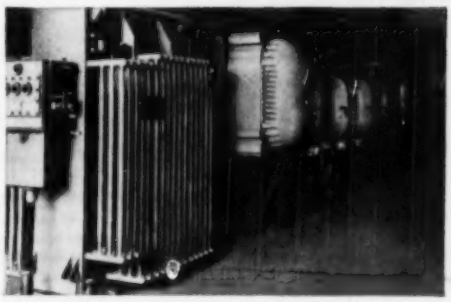
Simplicity is another advantage of this system. Operating personnel need no special training to operate and maintain the equipment contained in a double-ended unit substation—chiefly transformers and manually-operated drawout air circuit breakers.

Moreover, expansion is easy and economical. Single-ended or double-ended substations can be added at will. Since no added interrupting duty is imposed, no new secondary switchgear is needed on existing units. Full data is contained in Bulletin GET-1438, "Secondary Networks for Industrial Plants." Send for your copy today. ***Apparatus Dept., General Electric Company, Schenectady 5, N. Y.***

TO HELP CUT YOUR POWER DISTRIBUTION COSTS . . . Don't miss seeing the "More Power to America" full color and sound slide-film "Modern Industrial Power Distribution." It's packed with helpful, cost-cutting ideas you can use. Ask your G-E representative to arrange a showing for your organization.



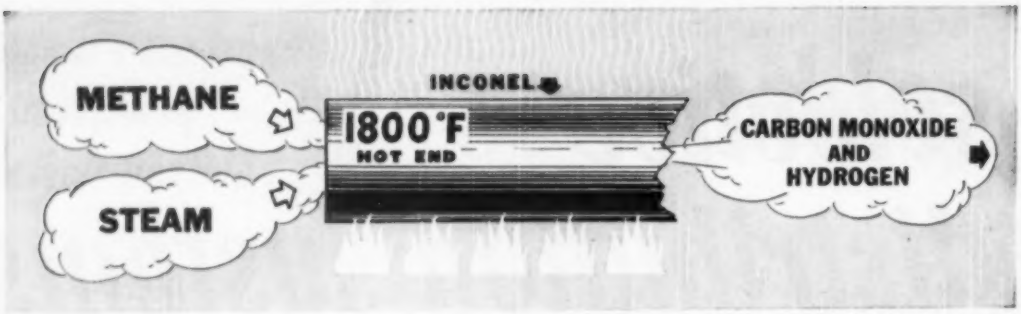
G-E double-ended load-center unit substations for non-hazardous areas are compact, factory-assembled "packages." Shipped ready to install, they are furnished in flexible combinations of incoming-line and secondary-circuit arrangements with transformers from 100 to 2000 kva.



For semi-hazardous areas, G-E double-ended load-center unit substations have easily removable air circuit breakers, each in Class I, Group D enclosures, plus primary power circuit breaker, a standard Pyranol (R) transformer section, and a secondary bus enclosure.

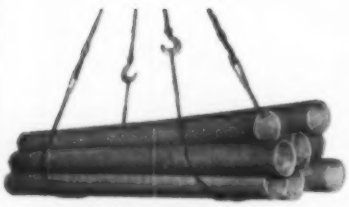
GENERAL ELECTRIC

661-12



Hydrocarbon Synthesis—FROM METHANE AND STEAM

WILL INCONEL BE THE ANSWER TO THE HIGH TEMPERATURE PROBLEM?



LARGE DIAMETER EXTRUDED INCONEL TUBING IN VARIOUS SIZES!

You can order extruded Inconel tubing in outside diameters from 2½" to 9½"; wall thicknesses from ¼" to ⅝". Length varies according to diameter; ranges from 6' to 22'. For closer tolerances and thinner walls, sizes up to 4½" O.D. are produced by cold drawing. Write for complete information.

Inconel* is rightly regarded as one of the outstanding metals for resistance to high temperatures.

Now the questions are being asked: *Is Inconel the answer to the hot-end of hydrocarbon synthesis? Will Inconel have a service life measured in years rather than hours?*

Already On Trial

Nobody can say—but at least one manufacturer is using Inconel tubing for experiments in fuel synthesis from methane and steam. In this particular case, the components enter the synthesizer hot-end at a temperature close to 1800° F., passing through an Inconel tube that is heated on the outside by the combustion of methane. Inside surfaces of the tube operate continuously under carburizing conditions; the outside is exposed to severe oxidizing conditions.

Inconel was chosen because of its proved hot-strength and resistance to creep and carburization.

Other High Temperature Service

Inconel has been used successfully by heat treaters in both strongly oxidizing and reducing conditions...at temperatures up to 2000°F. Inconel fixtures serving over two years are still in excellent operating condition.

REMEMBER *Inconel when you're looking for materials to resist carburization and oxidation at high temperatures in hydrocarbon synthesis. Turn some of your problems over to our Technical Service. These men know what has been done (and what is being done) to provide durable metals for your kind of work.*

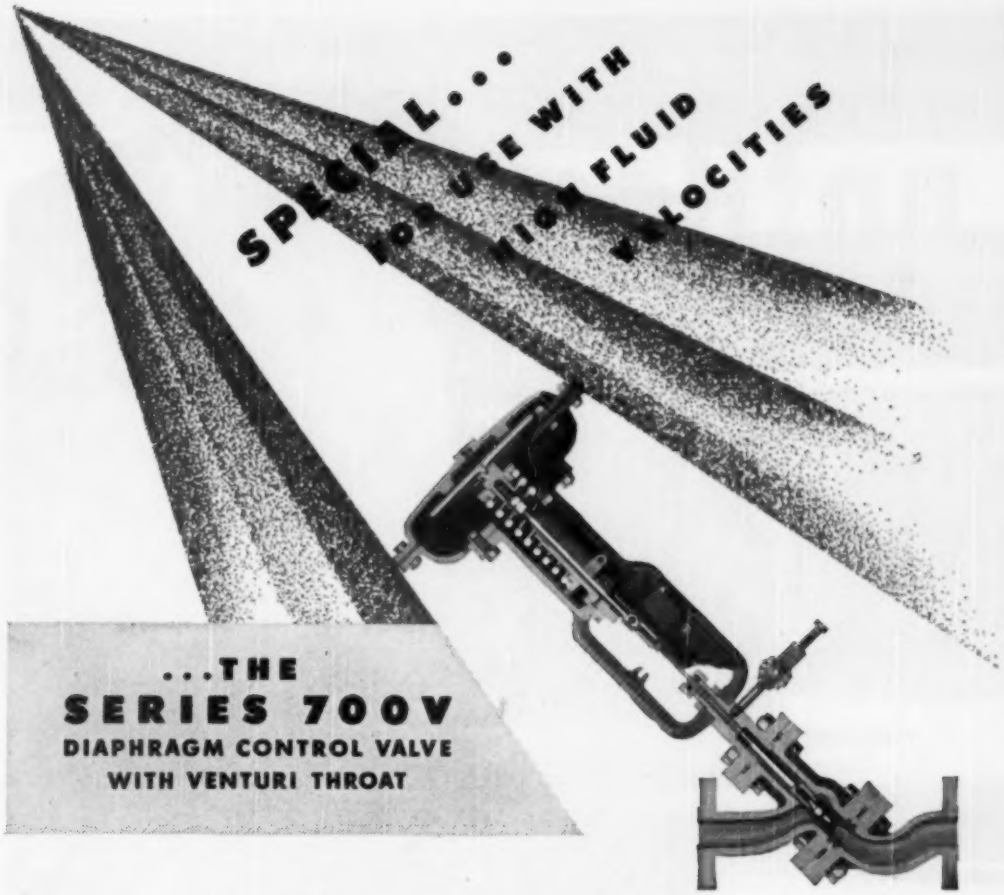
EMBLEM OF SERVICE
INCO
TRADE MARK

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

Inconel*—FOR LONG LIFE AT HIGH TEMPERATURES

*Reg. U. S. Pat. Off.

DESIGNERS and MANUFACTURERS! Sand castings and precision castings of Monel*, Nickel, Inconel* and other Nickel alloys are available from Inco's own foundry, backed by a half century of experience with Nickel and Nickel Alloys.



...THE SERIES 700V

DIAPHRAGM CONTROL VALVE WITH VENTURI THROAT

HIGH fluid velocities... even viscous fluids and fluids containing suspensions... are pushovers for the Series 700V. A special venturi throat eliminates the sudden change in direction of flow so often the cause of trouble under such conditions. As a result, in-service time is unusually high.

OUTSTANDING FEATURES OF THE 700V

- *Special flushing connection to keep stem operation free.*
- *Special materials for body and trim to meet prevailing operating conditions.*
- *Special design, renewable disc and seat ring.*
- *Special provision for field conversion from straight through to angle operation.*

You'll save a lot in maintenance costs alone, if you standardize on the Series 700V for high fluid velocities. Call in your local Honeywell engineer for complete information... he is as near as your phone!

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 1907 Windrim Avenue, Philadelphia 44, Pa. Offices in more than 80 principal cities of the United States, Canada and throughout the world.

COMMERCIAL · RESIDENTIAL · INDUSTRIAL
WORLD'S LARGEST ORGANIZATION FOR ADVANCED INSTRUMENTATION AND CONTROL

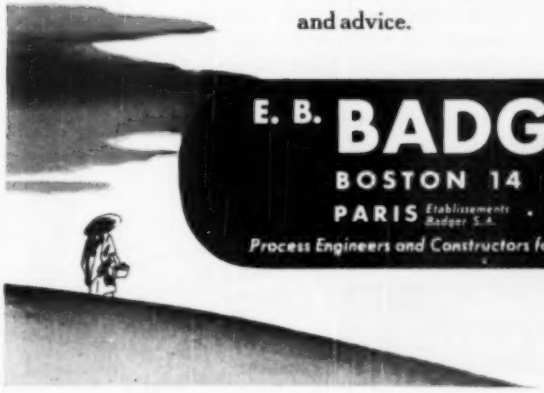
Honeywell
VALVE PRODUCTS

Cosmopolitan

Badger services have no geographical limitations. Badger-built refineries and processing plants are operating successfully all over the globe, from the deserts of Saudi-Arabia to the jungles of Burma, from Uruguay to Italy. The performance of these plants demonstrates Badger's "know-how" in applying broad experience to petroleum and chemical engineering work anywhere in the world, including adaptations to meet varying climatic conditions.

Wherever your project may be located, Badger will complete the design and procure all necessary materials either in this country or abroad. For the benefit of clients in the sterling area, engineering and purchasing services are provided by our London organization. This allows free choice in the most expedient allocation of currencies.

Facilities can be erected either by our own top complement of construction personnel or by local subcontractors operating under our general supervision and advice.



E. B. BADGER & SONS CO · Est. 1841

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Process Engineers and Constructors for the Petroleum, Chemical and Petro-Chemical Industries

more and better service
from

R·P&C
VALVES

...here's One Reason Why:

Over 60 years ago,
a PRATT & CADY Board of Directors
passed this resolution:

Resolved:

"That the superintendent
"shall be held responsible
"for the production of goods
"as near perfect in design,
"material and workmanship
"as shall make them merchantable
"and of a character that will serve
"to establish for this company
"a high reputation."

• This policy has remained unshaken through two world wars. The "high reputation" has been maintained. More than ever before, the valves offered by R·P&C meet the demand for longer and better service.

ACCO

Reading, Pa. • Atlanta • Baltimore • Boston • Chicago • Denver • Detroit • Houston
New York • Philadelphia • Pittsburgh • San Francisco • Bridgeport, Conn.

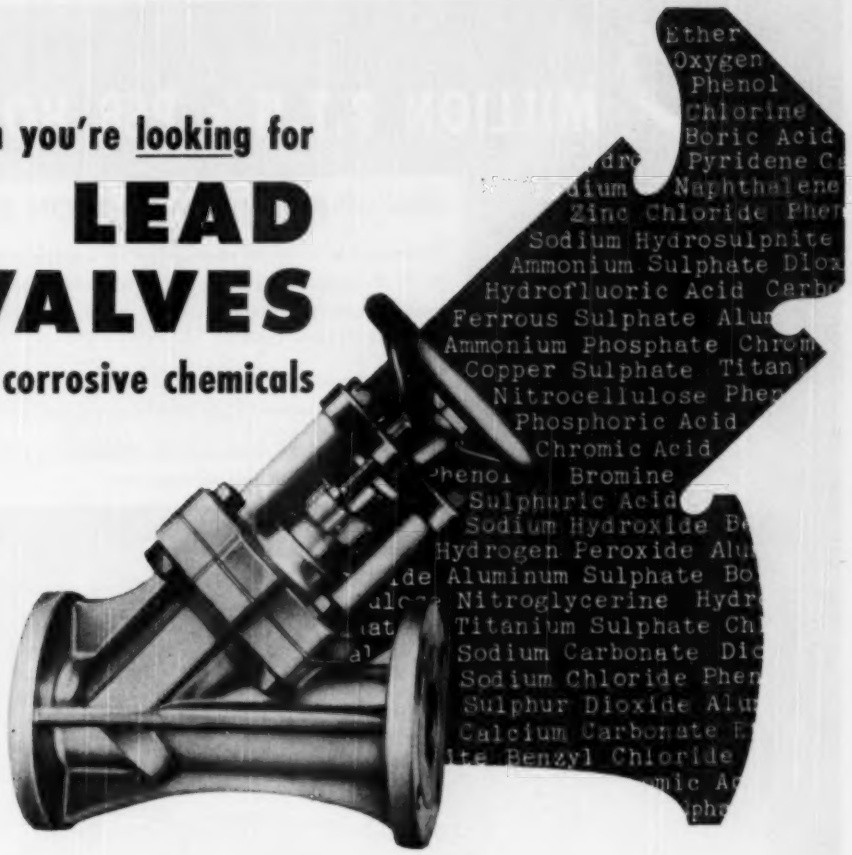
R-P & C VALVE DIVISION
AMERICAN CHAIN & CABLE

READING-PRATT & CADY VALVES

When you're looking for

LEAD VALVES

to control corrosive chemicals



Sturdiness, dependability, suitability...that's what you want in acid valves, isn't it?

And that's what you get in National Lead's "United" valves—valves made with "St. Joe chemical lead."

Sturdiness: National Lead valves are constructed to withstand stresses and overloads far beyond the demands of regular duty.

Dependability: The leader in lead, National Lead Company has the metal know-how...the acid control know-how...to design valves that make the most of lead's inherent corrosion resistance.

Suitability: To the selection of just the right valve, as well as the right alloys or other materials for critical parts, National Lead Company brings experience that covers the entire processing field.

Sturdiness, dependability, suitability...three good reasons for specifying National Lead's "United" valves. Available in a complete line that includes hard lead and lead-lined flanged acid valves; "Y" and angle patterns, gate, check, foot, and diaphragm valves.

Specify "United" whenever you need valves to control corrosive chemicals.

...look to the Leader in Lead

...in everything from lead pipe...valves...sheet...and lead-lined or lead-covered equipment...to complete acid recovery plants.

NATIONAL LEAD COMPANY

New York 6; Baltimore 3; Buffalo 3; Chicago 8; Cincinnati 3; Cleveland 13; Philadelphia 25; Pittsburgh 12; St. Louis 1; Boston 6 (National Lead Company of Mass.); Los Angeles 23 (Morris P. Kirk & Son, Inc.); Atlanta (Georgia Lead Works Div. of Cincinnati Branch); Toronto, Canada (Canada Metal Co. Ltd.).

DUTCH BOY PRODUCTS

Reg. U. S. Pat. Off.

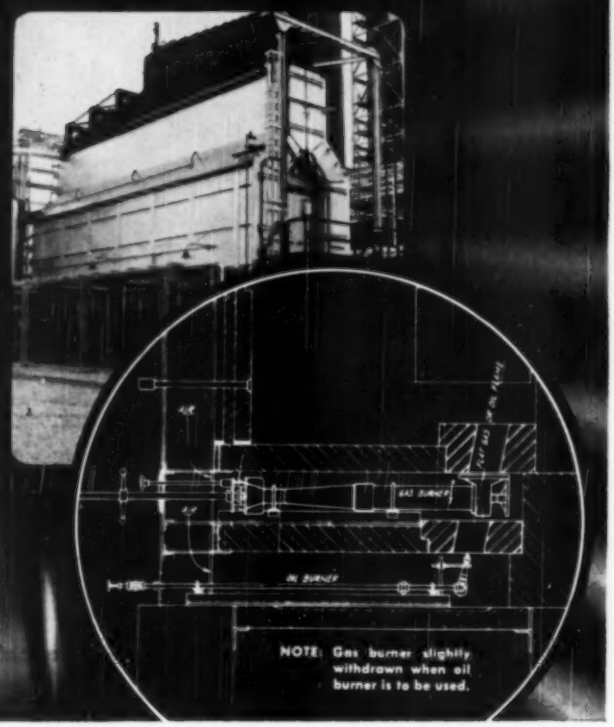
60 MILLION B.T.U.'s PER HOUR . . .

with UP-FIRED COMBINATION BURNERS

Unretouched interior photograph of a large center wall up-draft Petroleum Heater . . . fired vertically upward with twenty-eight (28) "National Airoil" flat flame gas-oil TANDEM COMBUSTION UNITS.

This design emphasizes an even flame distribution with uniform heat radiation to the absorption tubes.

Ask us about *your* particular installation or problem . . . we'll gladly comply with full information.



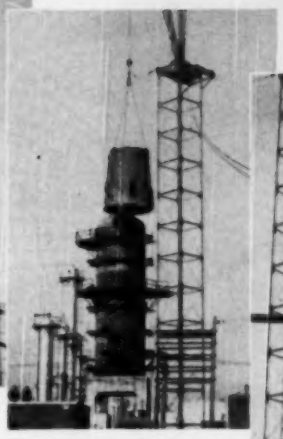
NATIONAL AIROIL BURNER CO., INC.

NAB

Main Offices & Factory: 1254 EAST SEDGLEY AVENUE
PHILADELPHIA 34, PA.

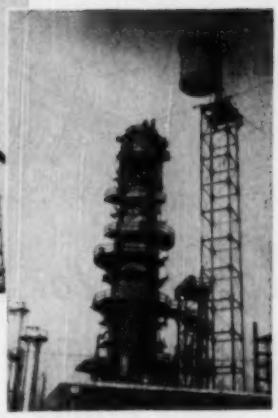
SOUTHWESTERN DIVISION: 2512 SOUTH BOULEVARD
HOUSTON 6, TEXAS

(1) Double-cyclones are lowered into position at the top of the regenerator.



(2) The conical joining section is placed in position on top of the regenerator.

(3) The bottom of the reactor rests on the conical section above the regenerator.



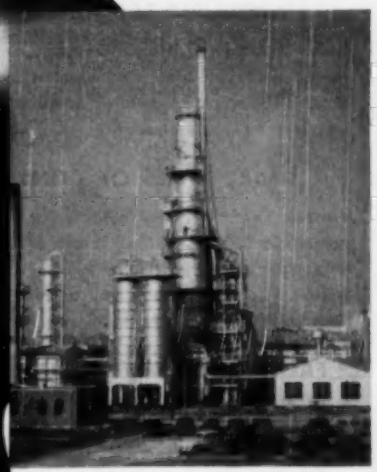
(4) The top of the reactor is hoisted into place. This completes the 2-in-1 unit.

Another 2-in-1 Cat Cracker erected in the field by Chicago Bridge

Here's another refinery that is using the new Universal Oil Products Company Fluid Catalytic Cracker, the compact 2-in-1 unit that has the reactor mounted above the regenerator. We erected this modern cracker at the Indianapolis, Indiana, refinery of the Rock Island Refining Corp.

This new unit produces propane, butane, high octane gasoline and light cycle stock which is further blended to produce domestic fuel oil No. 2. The unit has a rated capacity of 5,000 bbl. per day and replaces a thermal cracker reformer which has been converted to crude-distillation service.

Refinery towers are typical examples of the specialized structures we fabricate and erect for the petroleum industry. Let us work with you on your next job.



(5) The completed regenerator-reactor unit with two catalyst storage hoppers in the foreground.

CHICAGO BRIDGE & IRON COMPANY

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNSYLVANIA

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Chicago 4 ..... 2463 McCormick Building
Cleveland 15 ..... 2234 Guildhall Building
Detroit 26 ..... 1520 Lafayette Building
Havana ..... 402 Abreu Building
Houston 2 ..... 2126 National Standard Building
Los Angeles 17 ..... 1534 General Petroleum Building
New York 6 ..... 3302—165 Broadway Building
Philadelphia 3 ..... 1608—1700 Walnut Street Building
Salt Lake City 4 ..... 531 West 17th South Street
San Francisco 11 ..... 1251—22 Battery Street Building
Seattle 1 ..... 1331 Henry Building
Tulsa 3 ..... 1626 Hunt Building

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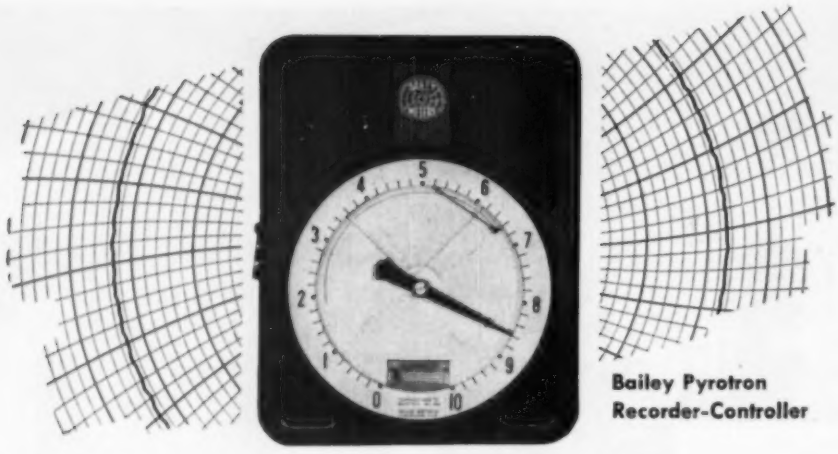

Bailey Pyrotron
Recorder-Controller

Looking for Better Temperature Instruments?

...Then check these features of Pyrotron Electronic Resistance Thermometers...

FUNDAMENTAL ACCURACY

Bailey Pyrotron Resistance Elements are made of highest purity platinum—the material used by the National Bureau of Standards in establishing basic standards for temperatures from −190°C to +660°C.

THREE TYPES OF CONTROL

Pyrotron Controllers may operate: on-off electrical systems by either electronic relays or electric contacts, modulated electronic systems, or air-operated systems. Two temperatures may be recorded on the same chart and controlled by a single instrument.

FACTS PUT INTO USABLE FORM

Bailey Pyrotrons may be arranged to put temperature facts into convenient usable forms. If two or more temperatures are related, they may be recorded as continuous records on the same chart for easy comparison. The average of several temperatures or the difference between two temperatures may be recorded as a single continuous record which may be retransmitted to a distant point or used to actuate a control system.

EASY INSTALLATION

Bailey Pyrotrons do not require careful leveling or protection against vibration. Three ordinary copper wires are all that is needed to connect each temperature sensitive element with the recorder. Power may be taken from any 115 volt 60 cycle circuit.

MINIMUM MAINTENANCE

The absence of galvanometers, batteries and standardizing equipment, together with the use of interchangeable unit assemblies, reduces Pyrotron maintenance to the vanishing point.

ABUNDANT POWER

A separate motor drive for each temperature furnishes abundant power to operate a recording pen, a controller and an alarm switch.

For the full story on this unusual electronic resistance thermometer which is suitable for ranges between −300°F and 1200°F, ask for Bulletin No. 230-C. P-21

BAILEY METER COMPANY

1043 IVANHOE ROAD • • • CLEVELAND 10, OHIO

Controls for Processing

TEMPERATURE
PRESSURE
% OXYGEN
% COMBUSTION
FLOW
LEVEL
DENSITY
RATIO

The symbol *"ESCO* 45" or *"ESCO* 20" cast on the corrosive handling equipment in your plant means that you will not pay the heavy cost of uncontrolled corrosion, nor suffer the loss of productive capacity which corrosion causes.

These *ESCO* stainless steels stop such losses before they start.

ESCO alloys 45 and 20 have proved to be exceptionally effective in refinery installations. Alloy 45 is an improved type 317, and has been used for years to combat corrosive conditions in pulp mills and food and chemical processing plants as well as refineries.

Alloy 20 (Duriron license) is a newer but thoroughly proved stainless steel that has been outstandingly successful in applications involving particularly vicious corrosion.

For certain conditions, other stainless alloys may be more effective. If a special analysis is required, *ESCO* is prepared to supply it in equipment that combines thorough engineering with closely controlled metallurgy and manufacturing processes.

The *ESCO* catalog of stainless and high alloy steel equipment outlines our facilities and services. Fill in and mail the coupon, and you will receive a copy promptly. You also are invited to write us of your corrosion problem, including details of corrosives used, their concentrations, temperatures, pressures, etc. We will do our utmost to be helpful to you.

ESCO STAINLESS AND HIGH ALLOY STEELS

ELECTRIC STEEL FOUNDRY

2181 N. W. 25TH AVENUE, PORTLAND 10, OREGON

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ELECTRIC STEEL FOUNDRY
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Please send me your catalog on stainless and high alloy steels in process equipment.

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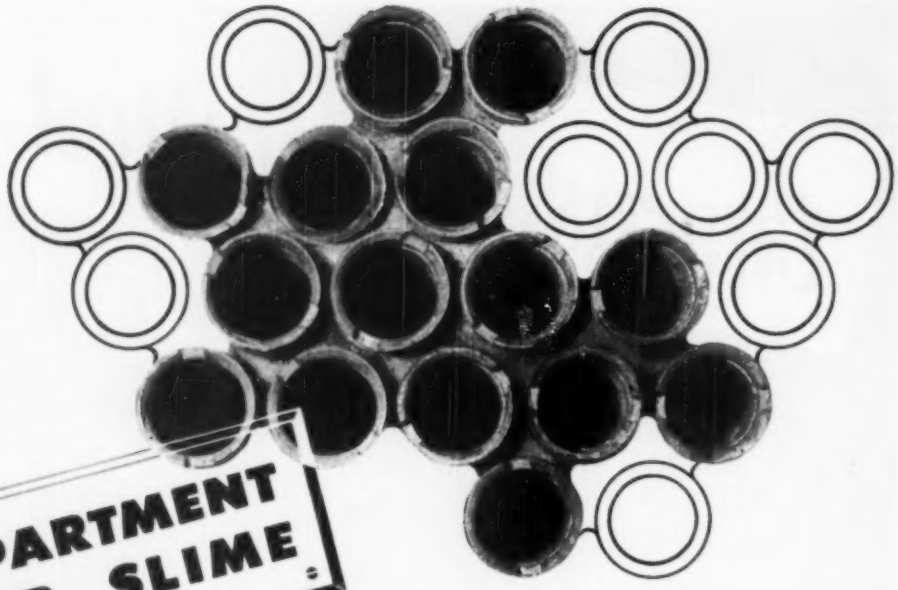
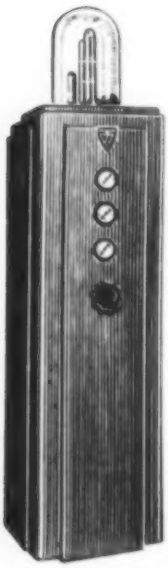


APARTMENT FOR SLIME

With condenser tubes handling unchlorinated water, slime-forming bacteria never have to worry about a housing shortage. Instead, these bacteria move in, form their colonies, and the condenser tubes become apartments for slime. When this happens, the terminal log mean temperature difference rises, excess steam costs go up, and outage increases along with the labor bill for costly plug cleaning.

Chlorination, engineered by W&T and backed by 35 years' experience, has proven itself the effective answer to slime in condenser and heat exchanging equipment. It is effective because the Wallace & Tiernan De-Sliming Process attacks the cause of slime, bacteria, and "evicts" these unwanted "tenants" from their home in your equipment.



CD-32

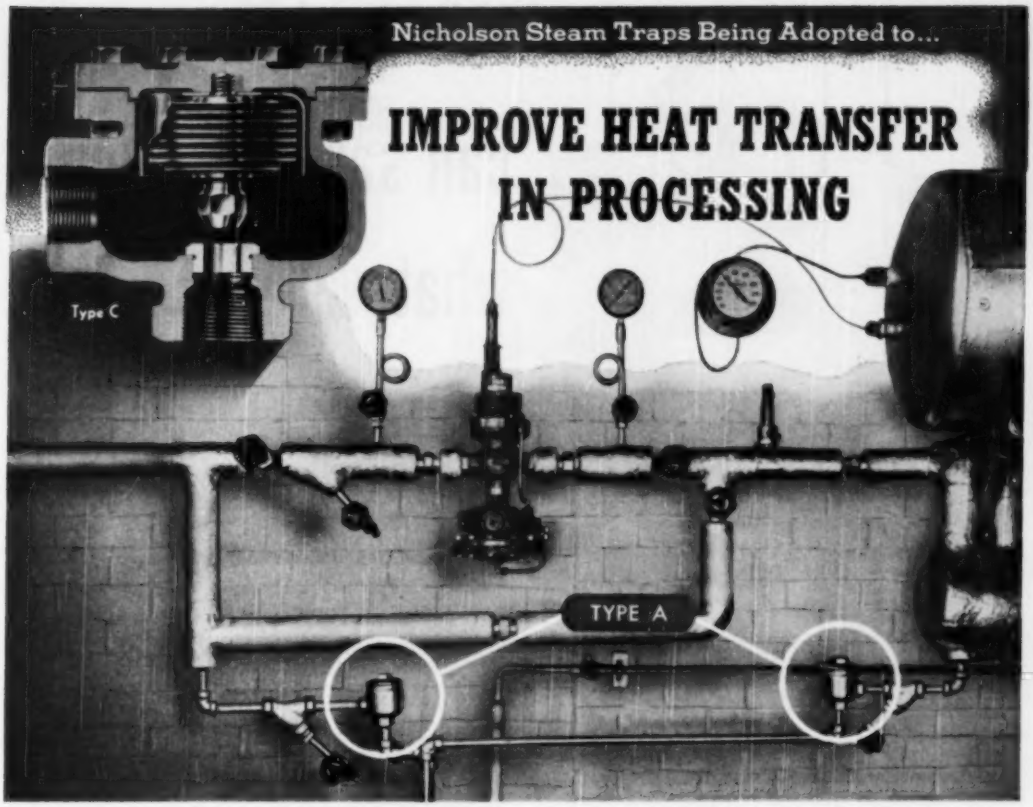
Regardless of whether yours is an open or closed cooling system or whether you use shell and tube, trombone, or open box condensers, Wallace & Tiernan engineering plus time-tested W&T Chlorinators can put all the money-saving advantages of slime control by chlorination to work on your condensers or heat exchange equipment.

Write today for complete information.

WALLACE & TIERNAN PRODUCTS, INC.

CHLORINE AND CHEMICAL CONTROL EQUIPMENT

Belleville 9, New Jersey • Represented in Principal Cities



Nicholson Traps Operate on Lowest Temperature Differential for Faster Action

The increasing adoption of Nicholson steam traps for critical process applications is a noteworthy indication of their advanced features.

Repeated tests show that Nicholson traps operate on low temperature differential: 5° to 15°, depending on trap size and steam pressure. Such prevention of condensate back-up explains the common usage of Nicholson traps for eliminating process variables in all sorts of heat transfer systems, tightening quality control and increasing production.

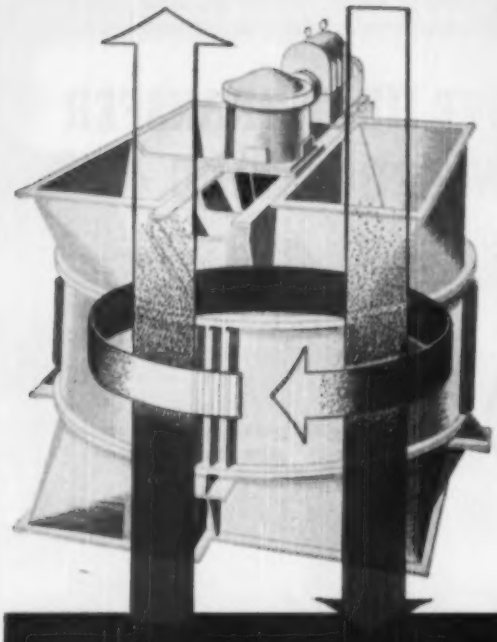
Other factors in the wide specification of Nicholson traps for recent technological advancements in processing are their large valve orifice and positive action. The valve of Nicholson traps is not only wide open at the start of the process cycle, when cold water and air are passing through, but remains open until steam contacts the trap bellows. Incidentally, these Nicholson features get equipment up to heat faster -- a reason why many plants standardize on Nicholson for all process, heat and power applications.

5 TYPES FOR EVERY APPLICATION, process, power, heat. Size ¼" to 2"; pressures to 225 lbs.

W. H. NICHOLSON & CO. 287
Oregon St., Wilkes-Barre, Pa.
Please send Bulletin 1047 describing Nicholson steam traps.
Name ..... Position .....
Firm .....
Address .....

W. H. NICHOLSON & CO.
207 OREGON ST., WILKES-BARRE, PA.

SEND FOR DATA ABOUT NICHOLSON'S ADVANCED FEATURES



this preheater can save you money whatever your fuel

the *Ljungstrom* AIR PREHEATER

The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves the heat is transferred from the waste gases to the incoming cold air.

All fuels burn better with preheated combustion air, and it is a "must" for many of them, such as high moisture powdered coal. In addition, the *continuous regenerative counterflow* principle of Ljungstrom permits reliable operation at low exit gas temperature. This assures the greatest possible heat recovery . . . reduces the amount of fuel required.

The efficiency and reliability of the Ljungstrom air preheater is a matter of record in industrial and utility plants throughout the country. That is why every year a constantly increasing percentage of the installed boiler capacity is equipped with Ljungstrom air preheaters.

If you are planning a new installation, or modernizing your present one, our engineers will welcome the opportunity to show you how the Ljungstrom can raise the efficiency of your plant.

THE AIR PREHEATER
60 East 42nd Street, New York 17, N. Y.
CORPORATION

Standard type Steel Gate Valve available in materials as specified.

WHEN YOU WANT

BOTH Precision and Economy

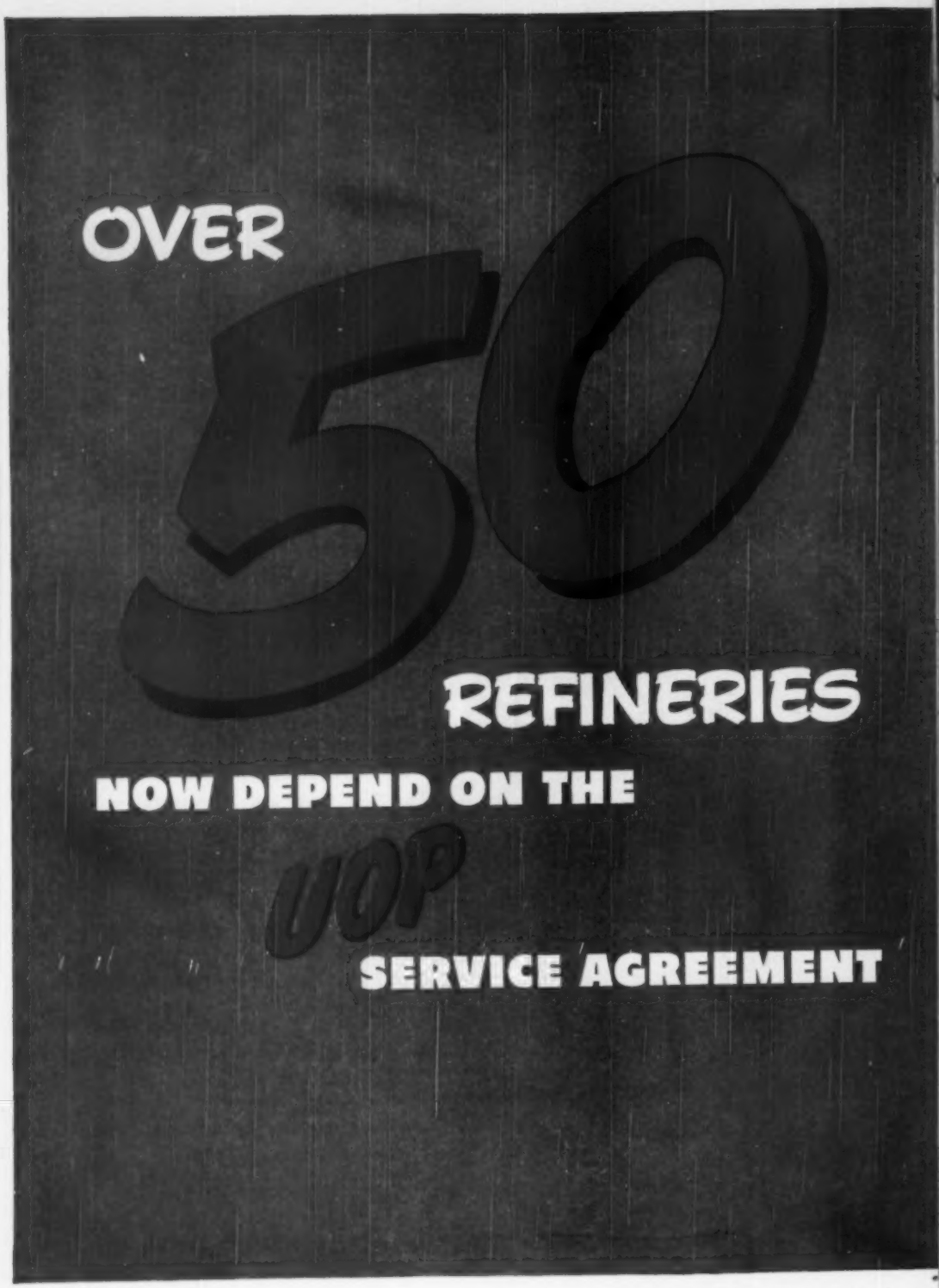
Specify CHAPMAN STEEL VALVES

Want valves with precision ratings that equal or exceed standard specifications? Then specify Chapman Valves. You'll find them the equal of custom-made valves *every time.* Yet they are economical — with the economy that comes from production line manufacture.

You'll find it will pay to specify Chapman Valves for every need — for longer service, for better service, for lower maintenance.

Available in gate, globe, angle or check types, and in materials suitable for every service condition.

The Chapman Valve Mfg. Co.
INDIAN ORCHARD, MASS.


OVER
50
REFINERIES
NOW DEPEND ON THE
UOP
SERVICE AGREEMENT

● Safe, efficient operation is of prime importance to any refiner. That's why more than fifty refineries already have turned to the UOP Service Agreement as the most definite assurance of safe, efficient operation available in the industry today.

The advantages of a UOP Service Agreement are of particular interest to every refiner regardless of size or location. The facilities, services and consultation available under this Agreement cannot be measured in terms of dollars invested, but rather in terms of dollars saved by having a thoroughly trained and experienced service organization available to assist you with the unusual as well as the normal problems of your refining operation.

Consider the benefits of having the advice and counsel of experienced engineers, technologists and refinery service men who are constantly dealing with an extremely wide range of refinery problems in both domestic and foreign operations.

And consider, also, what a UOP Service Agreement will save in "service dollars" while providing smooth, continuous operation of your refinery processing facilities.

Then, let's talk it over without delay.

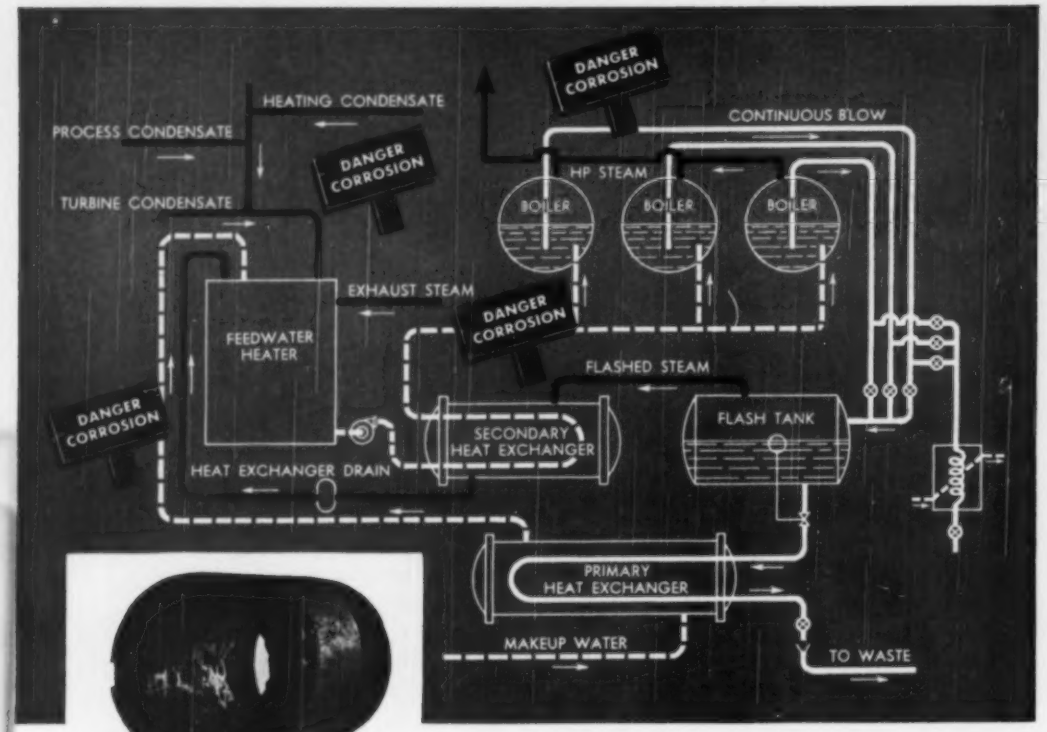
UNIVERSAL OIL PRODUCTS COMPANY

UOP

General Offices: 310 S. MICHIGAN AVE., CHICAGO 4, ILL., U.S.A.
LABORATORIES: RIVERSIDE, ILLINOIS

NEW EMPHASIS ON AN INDUSTRY BY-WORD

Universal Service Protects Your Refinery



AVOID These Danger Signs with BIRD-ARCHER Amine Treatment

CORRODED condensate return lines lead to expensive pipe replacement and maintenance. As an added annoyance, the solid products of corrosion often plug return lines and fill traps. You can steer clear of these troubles by using the *effective, economical* Bird-Archer Amine Treatment.

HERE'S THE WAY THIS B-A TREATMENT WORKS

Amines are fed into the boiler or into the steam and condensate systems. The amines raise the pH value of the condensate and also tend to inhibit equipment-destroying corrosion through surface protection of the metal itself.

HERE'S HOW THIS B-A TREATMENT SAVES MONEY

Raising the pH value of the condensate severely decreases maintenance costs by eliminating corrosion. These savings may more than offset the amount of treatment required to provide protection for your equipment.

NEW BULLETIN gives full details on the Bird-Archer Amine Treatment. . . . contains case histories that prove its successful application in many plants. *Write for your copy today.*

BA-154

WHAT AMINES ARE

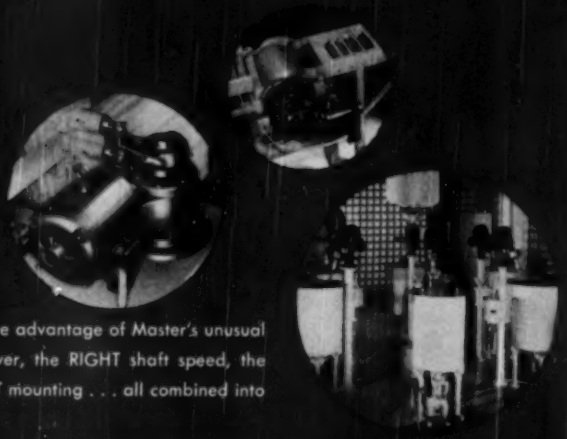
Amines are members of a class of chemical compounds in which one or more hydrogen atoms of the ammonia molecule are substituted by an organic group. Some of the simpler types are soluble and volatilize from boiler waters. The alkalinity of the amines is an inherent property and does not result from decomposition. *No free ammonia is released.* In the concentrations necessary for protection of condensate systems, amines are harmless to non-ferrous metals, non-toxic and are completely stable at temperatures approximating 675F.

BIRD-ARCHER WATER TREATMENT

THE BIRD-ARCHER COMPANY, 400 MADISON AVE., NEW YORK 17, N. Y.

Philadelphia, Pennsylvania • Chicago, Illinois • Montreal, Canada

CALDERAS Y ACCESORIOS, S. A. AMSTERDAM 291, MEXICO, D. F.



On big jobs or little ones it pays to take advantage of Master's unusual ability to supply the RIGHT horsepower, the RIGHT shaft speed, the RIGHT construction features, the RIGHT mounting . . . all combined into one compact power package.

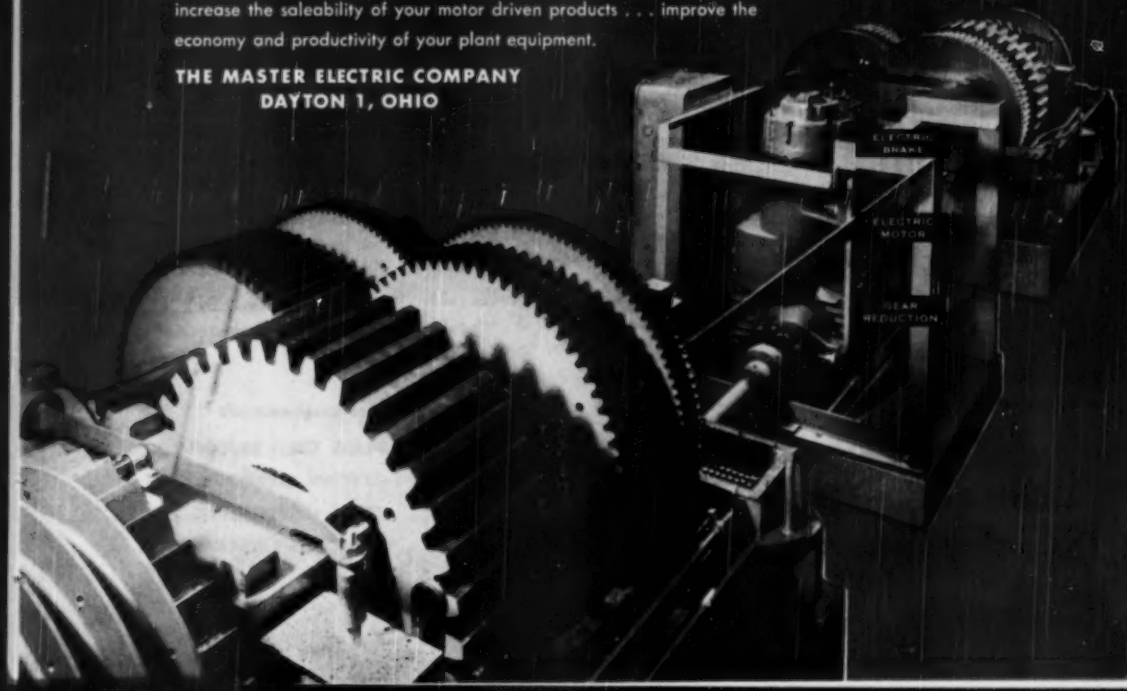
Don't put up with make-shift assemblies when you too may be enjoying these advantages. Master Motors, available in thousands and thousands of types and ratings (up to 150 HP) give you a selection you can get nowhere else.

Open, enclosed, splash proof, fan-cooled, explosion proof . . . horizontal or vertical . . . for all phases, voltages and frequencies . . . in single speed, multi-speed and variable speed types . . . with or without flanges or other special features . . . with 5 types of gear reduction up to 432 to 1 ratio . . . with electric brakes . . . with mechanical variable speed units . . . and for every type of mounting . . . Master has them all and so can be completely impartial in helping you select the one best motor drive for YOU.

BIG ones

Select the RIGHT power drive from Master's broad line and you can increase the saleability of your motor driven products . . . improve the economy and productivity of your plant equipment.

THE MASTER ELECTRIC COMPANY
DAYTON 1, OHIO



LEADING REFINERIES STANDARDIZE ON . . .

DA-1®

DAVISON FLUID SYNTHETIC CRACKING CATALYST

MAXIMUM catalyst utilization resulting in top efficiency and economy of operation is the reason most often given by leading refineries for standardizing on DA-1. Davison's close laboratory control over production maintains the high standard of uniformity in physical, chemical and catalytic characteristics of DA-1. It will pay you in increased cracking efficiency to investigate DA-1 . . . available in three grades . . .

F-1, Fine Grind—C-1, Intermediate Grind—C-2, Coarse Grind

For special processes, Davison can offer you an experienced staff and a modern, new plant devoted exclusively to the development and production of custom catalysts in granular, powdered or pelleted form.

Requests for information about DA-1—or any other Davison product or service—will secure immediate attention.

THE DAVISON CHEMICAL CORPORATION

Progress Through Chemistry

BALTIMORE-3, MD.

Davison offers you—

FACILITIES—Plants located in Baltimore and Cincinnati assure fast service and two reliable sources for your catalyst requirements.

EXPERIENCE—Producers of catalysts since the installation of the first fluid catalyst cracking plant.

SERVICE—New and expanded facilities for catalyst testing and evaluation.

Also producers of:

SILICA GEL • SILICOFLUORIDES
CASTING COMPOUNDS
ALUM • INORGANIC ACIDS
AGRICULTURAL CHEMICALS

CATALYTIC
POLYMERIZATION
Kellogg has engineered Catalytic Polymerization Units for
22 different refineries operated by:
• Argentine Government Oil Fields
• Anglo Iranian Oil Company, Ltd.
• British American Oil Co., Ltd.
• Continental Oil Company
• El Dorado Refining Company
• Globe Oil & Refining Company
• Gulf Oil Corporation
• Kanotex Refining Company
• Lion Oil Company
• Magnolia Petroleum Company
• Mid Continent Petroleum Co.
• Roosevelt Oil & Refining Corporation
• Skelly Oil Company
• Standard Oil Company (Ohio)
• The Texas Company
• Wasatch Oil Co.
• Wind River Oil & Refining Co.

More than 240 million gallons of 80+ octane* gasoline will pour this year from Kellogg "Cat-Poly" Units!

*CFR-M

. . . Yes! Kellogg-engineered "Cat-Poly" Units deliver more than 600,000 gallons of high octane blending-polymer every 24 hours . . . with additional capacity now building!

CATALYTIC POLYMERIZATION is, naturally, an important factor in modern refinery economics. It is one of the recognized methods that refiners may utilize to control their over-all refinery vapor pressure balance. Moreover, it is an excellent source for obtaining the high octane-blending stock necessary to meet today's gasoline quality standards.

However, initial cost of facilities and daily operating costs are two major factors refiners must examine closely if they are to gain full benefit from the process.

Along these lines, Kellogg has contributed greatly toward lowering initial costs by building units that utilize soaking drums from outmoded thermal crackers. In its continuing efforts to reduce daily operating costs, Kellogg has perfected a long-life catalyst that appreciably lengthens on-stream runs.

Having started better than fifteen years ago in the field of polymerization, Kellogg became one of the original members of the POLYCO group, which licenses the basic process. This development experience in the field of catalytic polymerization, plus an outstanding position in the building of commercial plants, should merit the careful consideration of every refiner considering the addition of polymerization facilities.

CATALYST LIFE ONCE A MAJOR PROBLEM IN "CAT-POLY" ECONOMICS . . .

Major factors in the daily operating cost of a Catalytic Polymerization Unit are the cost of catalyst and the down time required to replace it. Operating at high pressure ordinary catalysts have a tendency to agglomerate quickly, producing recurrent sudden pressure drops and requiring frequent and expensive replacement.

Kellogg tackled this problem and developed a new catalyst which retains its original pelleted form and resists softening better than other types on the market. Today Kellogg manufactures this catalyst in its own plant in Jersey City.

IT TAKES ALL SEVEN TO PRODUCE GREATER EARNING POWER . . .

1 THE DEVELOPMENT "TOOLS"
—laboratories, pilot plants and recognized specialists to prove and improve processing and equipment ideas.

2 PROCESS ENGINEERING
by three distinct groups of specialists—*sequence* engineers, *unit* engineers and *development* engineers—supported by an extensive reservoir of exclusive data.

3 SPECIALISTS IN EVERY PHASE
of design engineering due to the completeness of Kellogg's engineering staff.

4 SPECIALIZED BUYERS
backed by the cumulative buying power of the largest company in the business.

5 COMPLETE FABRICATING FACILITIES
to make schedule deadlines and to develop workable "firsts" in refinery equipment.

6. CONSTRUCTION KNOW-HOW
acquired in completing hundreds of major jobs, plus an ample supply of the proper tools, plus the development of new time-saving methods assure maximum efficiency on the construction lot. Kellogg's Construction Department has not only pioneered the use of such construction time-savers as guy derricks and pre-fab buildings but it has also developed, in connection with Kellogg labs, special welding, pipe-bending and stress-relieving techniques that have lowered construction costs and improved the efficiency of Kellogg-built plants. Permanent Kellogg construction crews, staffed from craft foremen up, operate throughout the United States, Canada, England, continental Europe, and South America.

7 PRACTICAL OPERATING COUNSEL
on all design and construction, achieved through practical operating men working as an integral part of the company.

. . . AND ONLY KELLOGG HAS ALL SEVEN!

The M. W. Kellogg Company, (a subsidiary of Pullman, Inc.), New York, Jersey City, Los Angeles, Tulsa, Houston, Toronto, London, Paris

Just TWIST its neck

Install the American Every Angle Thermometer in any difficult place, on an irregularly shaped tank, boiler or other equipment.

Then turn its face to the exact spot where you can see it best. If the light changes turn it again —as many times as you want— for it will survive many thousand turns without impairing its enduring accuracy.

It is adaptable to all types and shapes of process equipment for the neck can be moved and turned to a full 180 degrees on two axes.

This useful feature does not affect the accuracy in any way for the fine quality of American Thermometers has kept them leaders for a hundred years.

1850—1950
A Century of Service to American Industry

American Glass, Dial and Recording Thermometers are sold by leading distributors everywhere. Write to them or us for information.

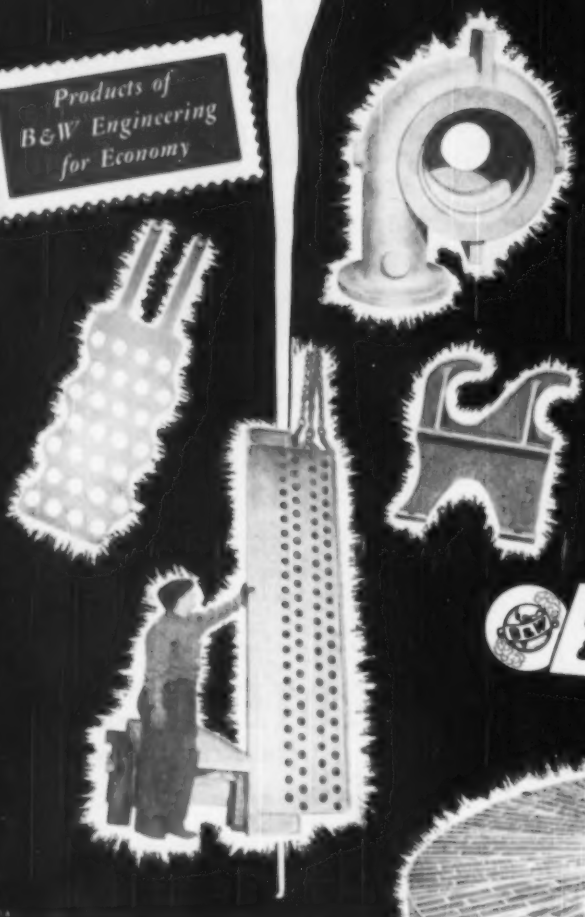
AMERICAN
Industrial Instruments

A Product of
MANNING, MAXWELL & MOORE, INC.
STRATFORD, CONNECTICUT

Makers of 'American' Industrial and 'Microsen' Electrical Instruments, 'Hancock' Valves, 'Ashcroft' Gauges, 'Consolidated' Safety and Relief Valves. Builders of 'Shaw-Box' Cranes, 'Budgit' and 'Load Lifter' Hoists and other lifting specialties.

Let B&W pour
LONGER LIFE
into YOUR processing equipment

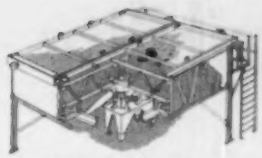
Products of B&W Engineering for Economy



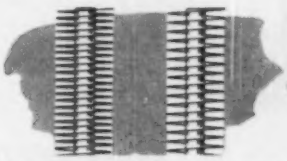
As vital parts in many types of petroleum processing equipment, B&W Alloy Iron and Steel Castings are demonstrating outstanding ability to resist abrasion, corrosion, and oxidation, and to retain high strength even at elevated temperatures. Operating in just about every kind of tough service, they are helping to keep production up by reducing costly, time-consuming repairs and replacements. Their long-life characteristics have been proved over and over in service temperatures up to 2000 F. and under conditions requiring high creep strength and wear-resistance.

Might pay you, as it has so many others, to call on our broad experience in solving processing problems with heat-resistant and wear-resistant alloy castings from our own modern foundries. The Babcock and Wilcox Co., 85 Liberty St., New York 6, N. Y.

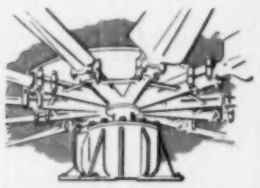
BABCOCK & WILCOX



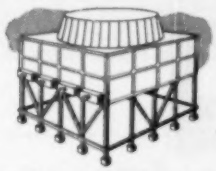
RIGID STRUCTURE . . . truss-sections give rigid but light design — requiring a small, inexpensive foundation. Rigidity assures longer-life coil sections.



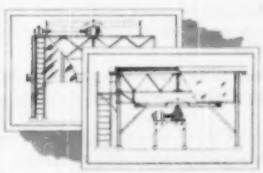
EFFICIENT FINNED TUBES . . . pressure bonded fins on tubes give high level heat transfer not dependent on solder joints. Various fins, tubes and headers available to meet any application.



PROVEN MECHANICAL EQUIPMENT . . . multibladed fans and rugged Geareducers team up to give quiet, smooth and dependable operation . . . regardless of weather or location.

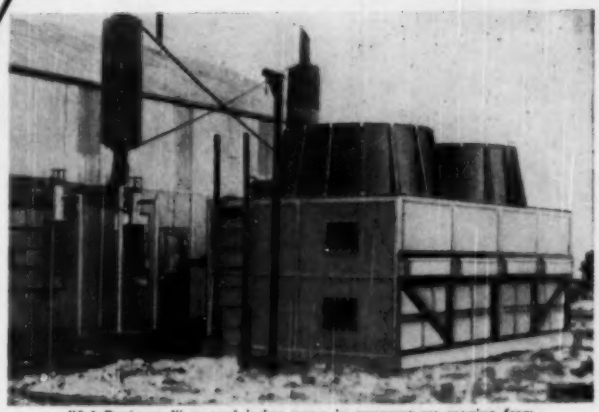


ALTERNATE MATERIALS . . . where corrosion is a problem, asbestos-board casing on a redwood frame requires little maintenance. Redwood, standard in cooling tower design, gives strong, durable and rigid support.



COMPLETE STANDARD LINE . . . induced draft or forced draft — portable or stationary — steel or redwood — various fin and tube materials and arrangements are offered by Marley to meet any application — usual or unusual.

Features like these . . . make MARLEY DriCooler® "JOB-ENGINEERED"



"Job-Engineered" to cool jacket water in temperatures ranging from −40F to 100F, an induced draft, asbestos-covered redwood structure.

No single design in an air-cooled heat exchanger will suit all applications. Cooling jacket water in below-zero temperatures, condensing gasoline on the sea coast or serving a pipeline compressor station in the desert . . . each is an exacting application . . . each requires a different type of unit. And that's why Marley has a complete line of DriCoolers available in all sizes and in a wide range of designs and materials.

After considering all factors, such as the fluids to be cooled — first cost — horsepower cost — weather conditions — corrosion and many other factors, Marley can make the best and most economical recommendation for your job.

Whether your job requires forced draft or induced draft design, steel or asbestos-board covered redwood structures, special fin or tube materials, you can be sure that your Marley DriCooler is "Job-Engineered" for your specific application.

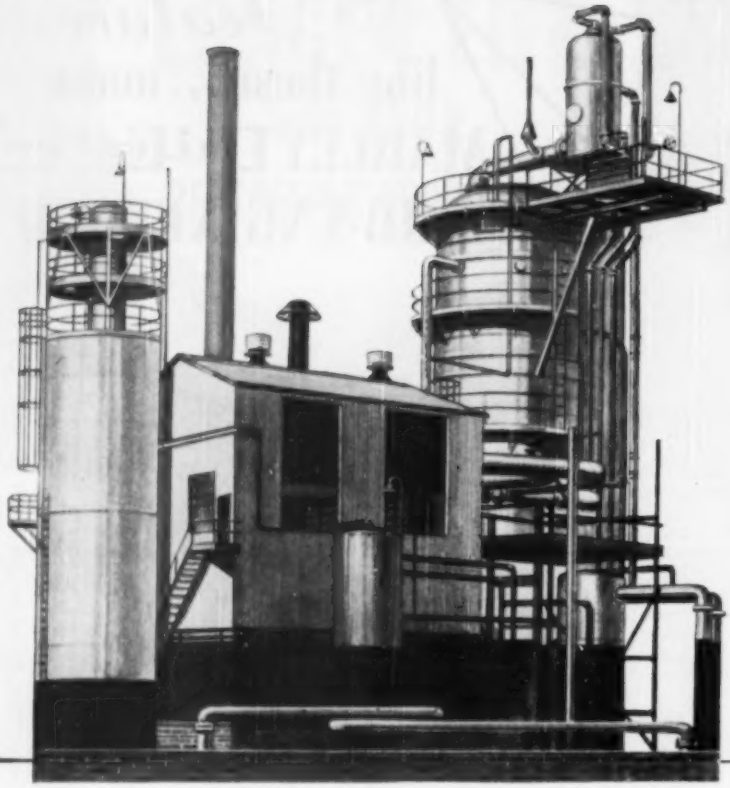
Let your Marley Application Engineer work with you from the "blueprint" stage on. Write, The Marley Company, Inc., Kansas City 15, Kans.

MARLEY

PB-6

Double-Flow Vairflo DriCooler Natural Draft Counter-Flow Aquatower Sorev Nozzles

Operating Flexibility



that permits Lube Refiners to choose end products at will

UNION OIL COMPANY NEW FILTROL FRACTIONATION UNIT AT OLEUM, CALIF.

One of America's most flexible lube plants has...

6 practical finishing methods available in its new Filtrol Fractionation Unit:

1. Filtrol fractionation of Duo-Sol extracted, propane dewaxed long residuals to produce a complete line of high V.I. motor oil blending stocks.
2. Filtrol fractionation of a phenol raffinate from a wax-free long distillate yielding motor oil blending stocks of intermediate V.I.
3. Contact Filtration of solvent extracted distillate and bright stocks in blocked operation.
4. Contact Filtration of acid treated and straight distillate stocks for industrial and spray oils.
5. Contact Filtration of specially treated phenol raffinates from distillate stocks for turbine and transformer oils.
6. During Contact Filtration operations, the fractionation tower may be used for re-running refinery distillates.

Operating control of this unit on any of these processing methods requires only two men per shift.

FILTROL CORPORATION

General Offices: 727 W. 7th Street, Los Angeles 17, Calif.
Plants: Vernon, California and Jackson, Mississippi

*TM Reg. U.S. Pat. Off.

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ADSORBENTS · CATALYSTS · DESICCANTS

Hell-fire or Brimstone

Flares burning hydrogen sulphide are wasteful and may be a dangerous nuisance. The disposal of hydrogen sulphide no longer is a costly problem . . . *it may be a profitable business.* Hydrogen sulphide now is being converted into valuable elemental sulphur . . . "brimstone". . . by Girdler-built sulphur plants. Investigate the Girdler GIRBOTOL plant for economical recovery of hydrogen sulphide from hydrocarbon mixtures and Girdler's sulphur plants of virtually any capacity . . . complete Girdler engineering and construction service for the entire project. Write today for details.

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THE GIRDLER CORPORATION

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DISTRICT OFFICES: 150 Broadway, New York City 7
2612 Russ Bldg., San Francisco 4
311 Tulsa Bldg., Tulsa 3

DESIGNERS, ENGINEERS AND CONSTRUCTORS

Few meters have

ANY *of these features—*

only HAGAN

RING BALANCE

has **ALL**

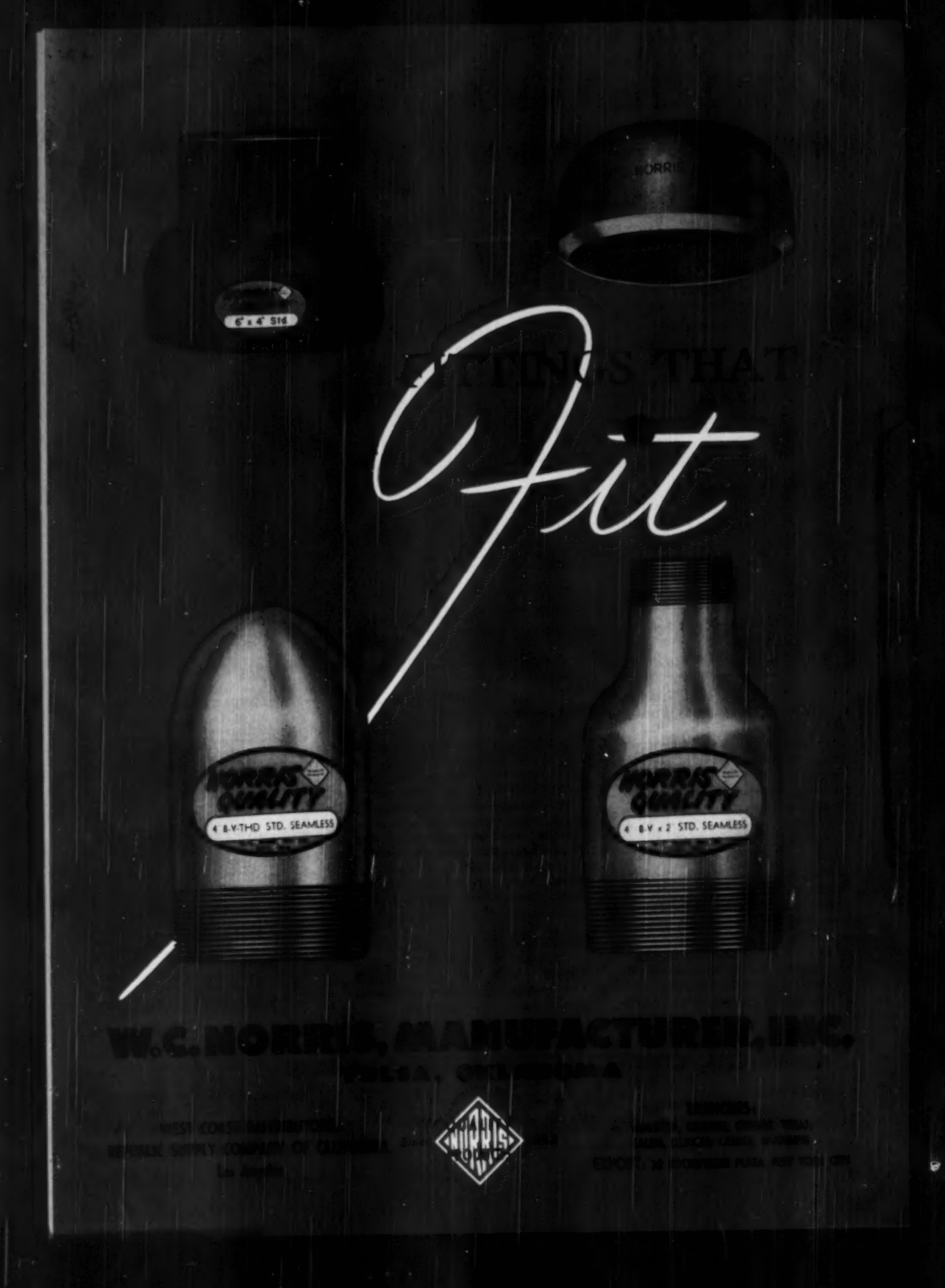
1. No stuffing boxes.
2. Mercury level not critical.
3. Dead-weight calibration.
4. Adjustable over a 7 to 1 range of differentials.

For full information on these meters, or on any application in which you are interested, write to Hagan Corporation, Hagan Building, Pittsburgh 30, Pa.

HAGAN CORPORATION

HAGAN HALL BUROMIN CALGON

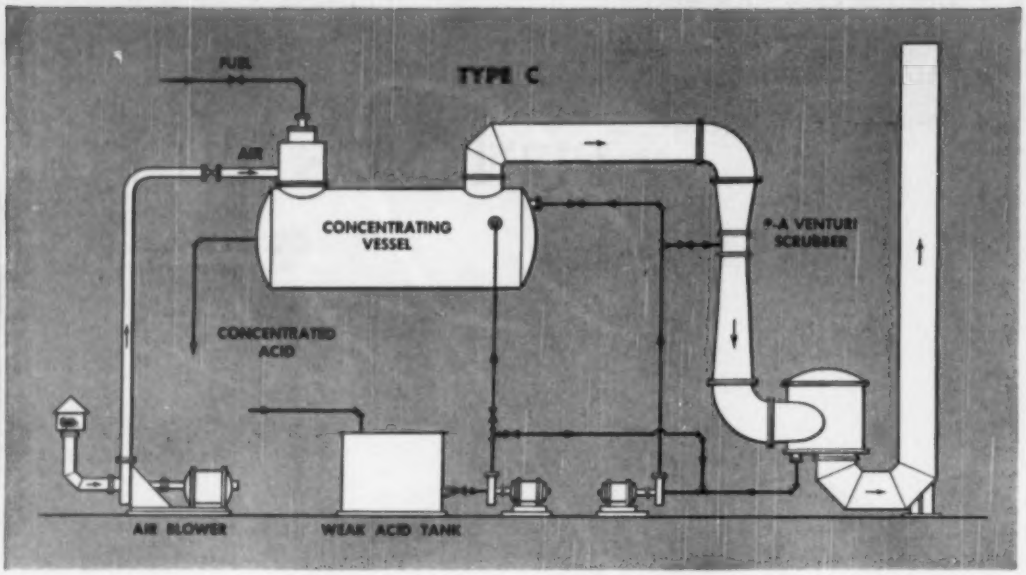
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
THRUSTORQ FORCE MEASURING DEVICES
BOILER COMBUSTION CONTROL SYSTEMS
METALLURGICAL FURNACE CONTROL SYSTEMS


6" x 4" STD
NORRIS
Fit
NORRIS QUALITY
4 8-V-THD STD. SEAMLESS
NORRIS QUALITY
4 8-V x 2" STD. SEAMLESS
W. C. NORRIS MANUFACTURER, INC.
NORRIS

Chemico Announces

NEW HIGH TEMPERATURE CONCENTRATOR

for spent sulfuric and phosphoric acids



THE NEW TYPE C High Temperature Acid Concentrator is a major improvement on the well known Chemico Drum Type Concentrator. This new unit is specially designed for concentrating spent sulfuric acid from petroleum refining, alcohol synthesis and nitrating operations as well as phosphoric acid from triple superphosphate operations.

The Type C unit employs the same principle as the Drum Type. Hot combustion gas is released under the surface of the acid where it gives up most of its heat and emerges at a temperature slightly above that of the acid itself. The combustion of the fuel takes place in the dip pipe, which withstands a high temperature on the *inside* and the corrosive action of acid on the *outside.*

But the new Type C Concentrator uses combustion gas at 2500F instead of 1100F. This high-temperature operation provides greatly improved heat efficiency. It also produces a much smaller volume of gas to be scrubbed at the concentrator exit. Here Chemico utilizes the recently developed and highly efficient P-A (Pease-Anthony) Venturi Scrubber which eliminates up to 99% of acid mist.

SEND FOR CHEMICO BULLETIN S-112, which fully describes this new Type C unit as well as the Type S Concentrator for acids containing soluble salts.

ADVANTAGES OF THIS NEW CHEMICO UNIT

1. Use of high temperature combustion gas assures high heat efficiency.
2. Retains the best features of the Chemico Drum Type Concentrator.
3. Low initial investment.
4. Low operating cost.
5. Low maintenance cost.
6. Acid concentration through all ranges of strength up to 96%.
7. High acid recovery.
8. Built-in fume eliminator (P-A Venturi Scrubber).
9. Specially adapted for use on acids containing salts as, for example, waste pickling solutions.
10. No heat transfer surfaces to cake up.
11. Fully guaranteed by Chemical Construction Corporation who have more than 35 years of experience in this field and a background of more than 200 successful concentrating unit installations.

CHEMICAL CONSTRUCTION CORPORATION

A UNIT OF AMERICAN CYANAMID COMPANY

488 MADISON AVENUE, NEW YORK 22, N. Y.

EUROPEAN TECHNICAL REPRESENTATIVE
CYANAMID PRODUCTS LTD., BRETTENHAM HOUSE, LANCASTER PLACE, LONDON W. C. 2, ENGLAND

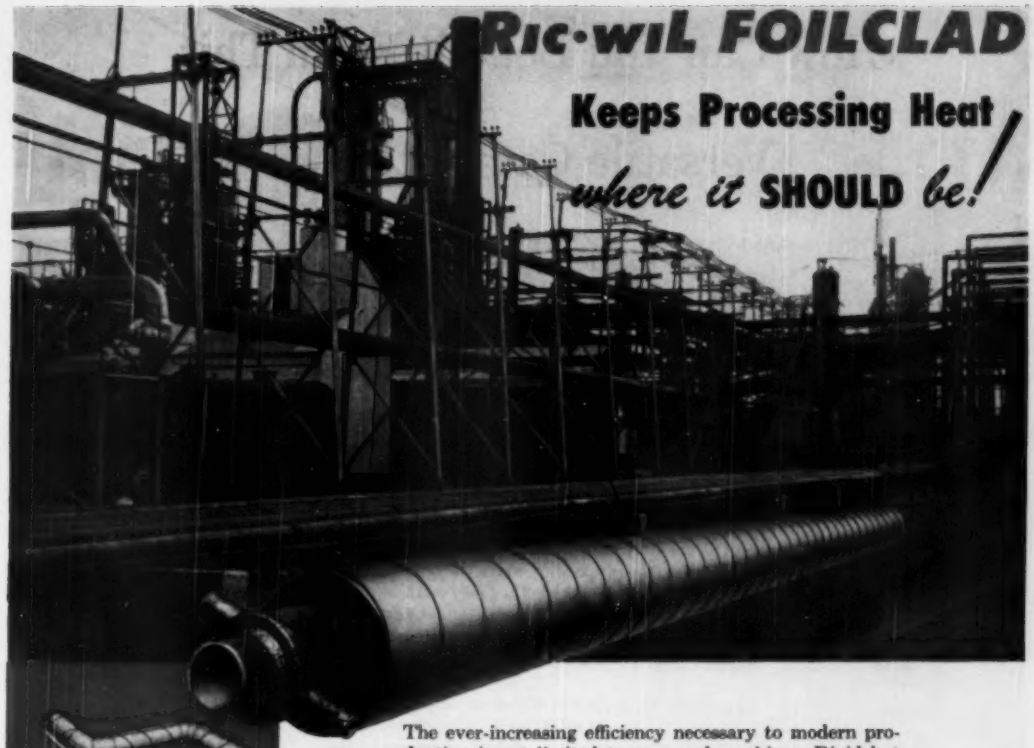
CABLES: CHEMICONST, NEW YORK

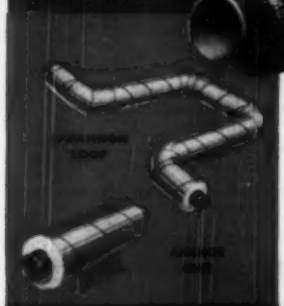
CC-195

Chemico Plants are Profitable Investments

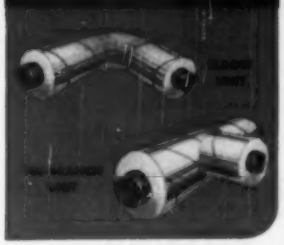
Ric·wiL FOILCLAD

Keeps Processing Heat *where it* SHOULD *be!*





PREFABRICATED FOILCLAD ACCESSORY UNITS . . .



The ever-increasing efficiency necessary to modern production is not limited to men and machines. Rigid hot or cold temperature control is a prime factor in processing where the insulated piping must carry component liquids or gases *in an unbroken operating cycle — at exact processing temperatures.*

Ric-wiL FOILCLAD Prefabricated Insulated Piping Systems are used by many manufacturers to provide their processing systems with the highest thermal operating efficiency and lowest maintenance costs. The ease of installation of Ric-wiL FOILCLAD Systems and their high resistance to moisture and corrosion make them the choice of efficiency-minded operators.

Prefabricated to fit your specific system requirements, Ric-wiL Systems are backed by forty years of engineering, designing, production and installation experience devoted solely to insulated piping.

Our representative nearest you will be glad to give you detailed Ric-wiL technical information as related to your specific processing problem.

For full technical information on Ric-wiL Insulated Piping Systems, call or write the Ric-wiL office nearest you or Dept. 6-EA in Cleveland, Ohio.

Ric·wiL
INSULATED PIPING SYSTEMS

OVERHEAD — THE RIC-WIL COMPANY · CLEVELAND, O. — UNDERGROUND

FOR FORTY YEARS THE GREATEST NAME IN INSULATED PIPING SYSTEMS

How Can You Benefit From This Versatile Catalyst? BF_3

Boron Fluoride

ETHER COMPLEX, PHENOL COMPLEX OR COMPRESSED GAS

UNUSUALLY VERSATILE Boron Fluoride offers important advantages for a wide range of reactions. Some of these are listed at right. Such benefits merit thorough investigation in any operation where the catalytic properties of BF_3 can be utilized. They may mean increased economy and efficiency in your process too! Further information helpful in evaluating BF_3 for your needs is available from any B&A office.

AS A PIONEER in the field of fluorine compounds, Baker & Adamson introduced BF_3 Etherate to industry a number of years ago. Today it also offers the Compressed Gas and Phenol Complex in commercial quantities. In addition, extensive production and research facilities place B&A in a preferred position to work with you in development of other BF_3 complexes to meet individual specifications.

SOME ADVANTAGES BF_3 OFFERS IN PROCESS USE:

- Operating temperature ranges are wider.
- Yields are increased.
- Separations are easier and no bulky sludges are formed.
- Properties of end-products are improved.
- More reactions are carried to completion.
- Fewer undesirable waste materials result.
- Smaller quantities have greater catalytic activity.
- Little or no extraneous material is introduced into the system.
- Reactions are moderated or more easily controlled.

USES OF BORON FLUORIDE AS A CATALYST

1. Polymerization and co-polymerization of mixed unsaturates.
2. Selective esterification of mixtures of organic acids.
3. Cyclization of synthetic and natural elastomers after polymerization or in starting from monomers.
4. Condensation of modified phenolics.
5. Preparation of alkyl phenols.
6. Refining of aromatic and paraffinic solvents by polymerization of the olefins they contain.
7. Modification of mixtures of esters and acids by polymerizing conjugated compounds selectively.

REAGENTS B&A STANDARD OF PURITY FINE CHEMICALS

BAKER & ADAMSON *Fine Chemicals*

GENERAL CHEMICAL DIVISION
ALLIED CHEMICAL & DYE CORPORATION

40 RECTOR STREET, NEW YORK 6, N. Y.

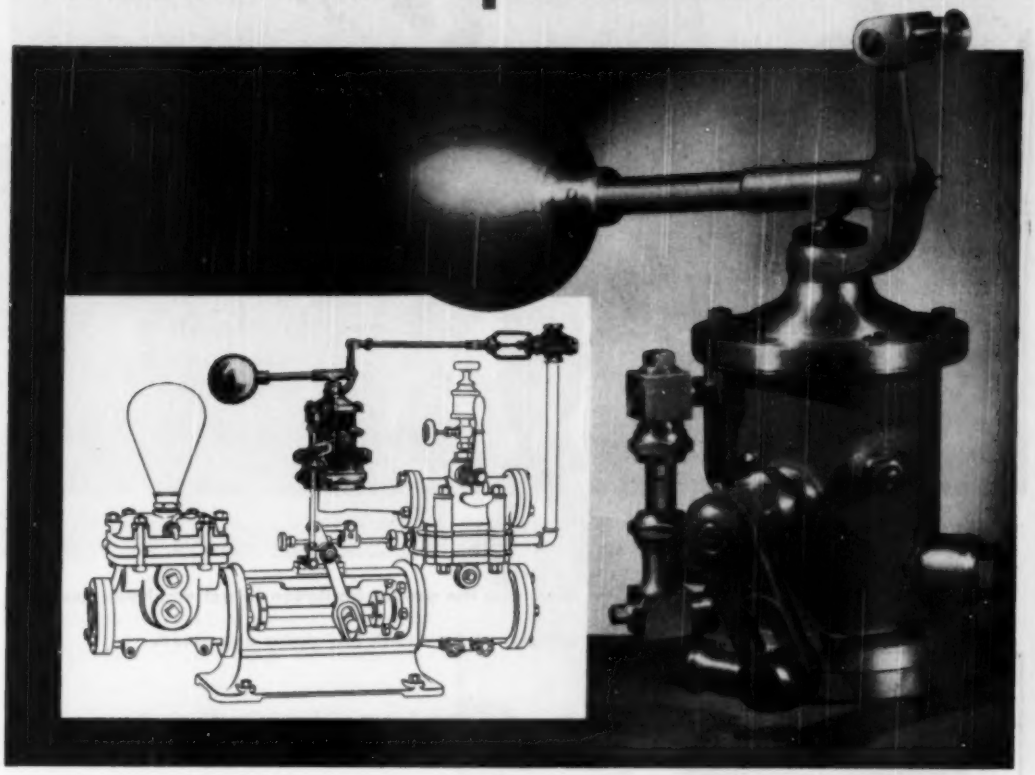
Offices: Albany* • Atlanta • Baltimore • Birmingham* • Boston* • Bridgeport* • Buffalo* • Charlotte* Chicago* • Cleveland* • Denver* • Detroit* • Houston* • Los Angeles* • Minneapolis • New York* Philadelphia* • Pittsburgh* • Portland (Ore.) • Providence* • St. Louis* • San Francisco* • Seattle Wenatchee (Wash.) • Yakima (Wash.)
In Wisconsin: General Chemical Company, Inc., Milwaukee, Wis.
In Canada: The Nichols Chemical Company, Limited • Montreal* • Toronto* • Vancouver*

SETTING THE PACE IN CHEMICAL PURITY SINCE 1882

* Complete stocks are carried here.

Prevent Possible Pump Damage by Maintaining Uniform Speed with

Masoneilan Speed Governors

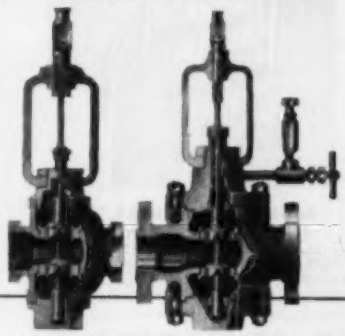


These governors prevent possible pump damage through overspeed. You automatically maintain uniform speed of simplex or duplex, double- or single-acting reciprocating steam pumps, and all classes of flywheel pumps, including vacuum pumps, air compressors and ice machines with Masoneilan Over-Speed Governors.

Look at these Mason-Neilan operating features — Speed may be adjusted while pump is in motion . . . Motion arm may be arranged either vertically or horizontally . . . Governor may be refilled while pump is in motion.

You can profit with Masoneilan Steam Pump Speed Governor. Write for information.

MASONEILAN CONTROL VALVES



These valves (No. 154-2) are especially designed for use with Masoneilan Speed Governor.

Sizes from ½" through 2", with V-port valve plugs; Body Ratings: Bronze 250 lbs. at 475°F.; Steel 300 lbs. at 750°F.; Iron class 250 at 450°F.

MASONEILAN

MASON-NEILAN REGULATOR COMPANY

1182 ADAMS STREET, BOSTON 24, MASS., U. S. A.

Sales Offices or Distributors in the Following Cities: New York • Syracuse • Chicago St. Louis • Philadelphia • Houston • Denver • Pittsburgh • Cleveland • Cincinnati Tulsa • Atlanta • Los Angeles • San Francisco • Salt Lake City • El Paso • Boise Albuquerque • Detroit • Charlotte, N. C. • Mason-Neilan Regulator Co., Ltd., Montreal and Toronto

He's the man who can show you the proper insulation to get maximum heat and power from each fuel dollar expended.

Here's one insulation that will save you money

EAGLE-PICHER SUPER "66" INSULATING CEMENT

Super "66" is all-purpose, rust-inhibitive, extremely adhesive insulating cement. "Springy ball" pellets don't collapse after application . . . give great coverage, retain their thermal efficiency. 100 lbs. covers 65 sq. ft.—1 inch thick! Easily applied with trowel, over flat and irregular surfaces. Efficient for temperatures up to 1800°F. Reclaimable when used on equipment whose temperatures do not exceed 1200°F.!

An Eagle-Picher Industrial Insulation distributor or representative can help you reduce operating expenses because he has available a wide line of insulation products—for high and low temperatures—scientifically designed for maximum thermal efficiency, and practical application. Why not let him give you more information about some of the products listed here?

These Eagle-Picher products can save you money . . . power . . . time

Insulating Felts • Supertemp Blocks • Blankets
Loose Wool • Pipe Covering • Stalastic • Insulseal • Insulstic
Swetchek • Finishing Cements • Insulating Cements
Fireproofing Cement • Diatomaceous Earth Blocks

THE EAGLE-PICHER COMPANY

General Offices: Cincinnati (1), Ohio

Insulation products of efficient mineral wool—for a full range of high and low temperatures. Technical data on request.

EAGLE EP PICHER

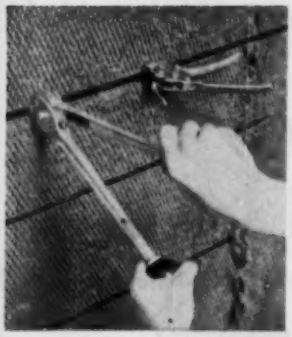
Since 1843

Get maximum fuel savings and exact temperature control with these versatile, efficient insulations

For a completely effective, low-cost insulation combination, you can't beat the teamwork of Eagle-Picher Mineral Wool Blankets, Supertemp Blocks, Super "66" Insulating Cement, No. 106 Fireproofing Cement and Insulseal. They work effectively to give your equipment highest possible thermal efficiency . . . cut operating costs by saving maximum amount of fuel . . . and help to provide perfect, precise control over temperatures.

EAGLE-PICHER FIREPROOFING CEMENT

Mixed with water to form a stiff plastic mix for easy application on ribbed lath. Recommended for fireproofing structural steel columns, steel tank supports, skirts and equipment bases. Has high dry coverage of approximately 30 sq. ft. 1 inch thick per 100 pounds. Adds fire protection, patented rust-inhibitor resists corrosion. Tested by Underwriters' Laboratories, Inc.



EAGLE-PICHER MINERAL WOOL BLANKETS

These blankets satisfy the need for a convenient method of quickly and efficiently insulating flat or curved surfaces on larger types of heated equipment. Mineral wool is felted and secured between flexible metal fabric. Outstanding physical and chemical stability enables Eagle-Picher Blankets to resist water, steam, corrosive fumes and normal vibration.

EAGLE-PICHER SUPERTEMP BLOCKS

Eagle-Picher Supertemp Blocks are lightweight (approximately 16 lbs. per cu. ft.). Can be cut easily with knife or saw to fit off-shaped areas . . . they fit snugly over minor irregularities. They're strong and have high refractory value. Withstand temperatures up to 1700° F. Conductivity at 512° F. approximately 0.43 . . . all standard sizes, from 3" x 18" to 12" x 36" . . . in thicknesses from 1" to 4".

EAGLE-PICHER INSULSEAL

A tough, weatherproof, protective coating for insulation. For temperatures up to 450° F. Applied as a plastic, its smooth troweling qualities assure uniform coverage, proper thickness. It protects insulation from air infiltration, fumes, rain, snow, vibration, punctures, and withstands severe service, indoors or out. Dries to a smooth, rich black, has a neat appearance on hot or cold surfaces . . . may be washed or painted.

THE EAGLE-PICHER COMPANY General Offices: Cincinnati (1), Ohio

Insulation products of efficient mineral wool—for a full range of high and low temperatures. Technical data on request.

EAGLE EP PICHER *Since 1843*

Cut Refinery Operating Costs

by specifying

ANNIN Domotor and Hand-Operated Valves

Reduce Valve Inventories and Maintenance Costs

COMPLETE INTERCHANGEABILITY

The advantage of specifying *both* Domotor Control Valves and Annico Figure 15 Manual Valves in refinery service lies in the fact that all parts from the yoke down are interchangeable. Obviously, your inventory of spare parts . . . representing a non-productive capital investment . . . can be reduced appreciably. This arrangement permits a flexibility in operation since a control valve may be converted to a manual valve in a matter of minutes. Quick opening, linear or percentage fluid control characteristics for any application is provided by simple change of valve trim. Where positive, bubble-tight shut-off is required, the Teflon seat seal can be installed in either assembly.

QUICK OPENING PLUG

LINEAR PLUG

PERCENTAGE PLUG

LOW COST MAINTENANCE

The Annin valve body separates at the replaceable seating ring. By removing one flange and the outlet half of the body, the stem and plug assembly, seat ring, guide bushing, packing and all other operating parts can be replaced on the job, without removing the valve from the line. The seating ring is positively positioned in relation to the valve plug, eliminating costly grinding-in operations. Valuable time is saved because of the reduced servicing interval required by Annin Valves.

It will pay you to investigate Annin Valves

WRITE TO: **THE ANNIN COMPANY**

3500 UNION PACIFIC AVE., LOS ANGELES 23, CALIFORNIA

DOMOTOR CONTROL VALVE

For precision control of hard-to-handle fluids. Powerful piston action is combined with extreme sensitivity and stability. Integral null type positioner eliminates external attachments. Sizes ½" to 4"; Pressures to 3000 psi; Temperature Range: −300° F. to 1000° F. Available in almost any castable alloy.

ANNICO HANDWHEEL VALVE

Figure 15 Manual Valve in shut-off service is a valuable companion to the Domotor Control Valve. By taking advantage of the interchangeable characterized trims offered, this valve becomes ideal for batch and non-continuous fluid processing control. Operates over the same service range as the Domotor.

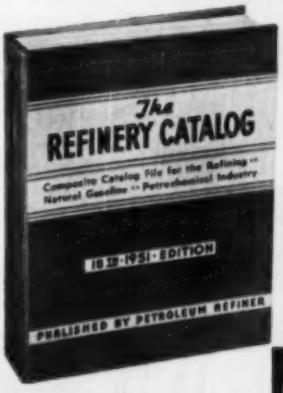
12 Acid Resisting Valve Manufacturers

HAVE THEIR CATALOGS FILED IN

The Refinery Catalog

To Make Your Buying Job Easier

More than 300 leading manufacturers of pressure controllers and approximately 2,000 other classifications of process plant equipment distribute their catalogs in Refinery Catalog . . . *to make your buying job easier.* When buying or specifying refinery, natural gasoline, or petrochemical plant equipment reach for your copy of Refinery Catalog, you'll find complete catalog data handily indexed, quickly obtainable. Make your buying job easier—look it up in Refinery Catalog.


The
REFINERY CATALOG
Composite Catalog File for the Refining -- Natural Gasoline -- Petrochemical Industry
PUBLISHED BY PETROLEUM REFINER

REFINERY CATALOG

THE UNIVERSAL EQUIPMENT GUIDE FOR REFINERY BUYERS

THE STEPS GET BIGGER AND BIGGER

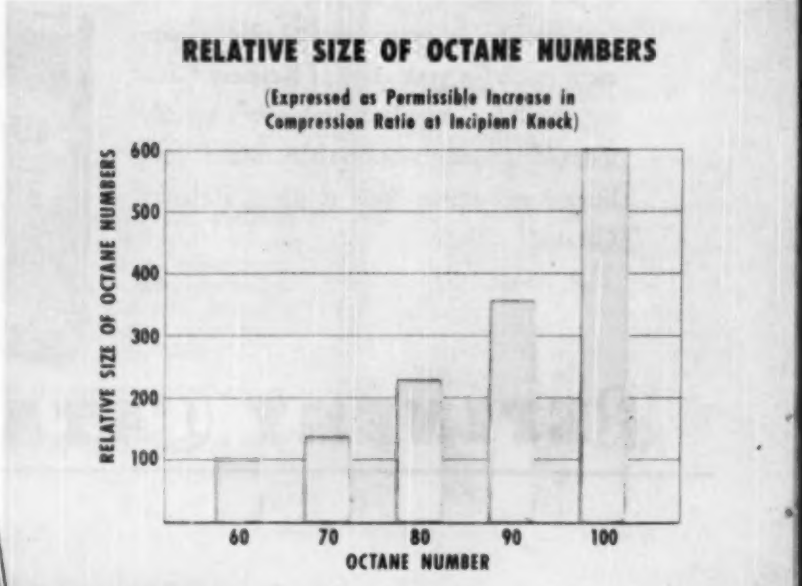
THE Octane Number Scale is a useful tool for the control of gasoline quality. However, it does not give a complete indication of what fuels can deliver in an engine.

On the Octane Number Scale, one unit appears to be equal in size to every other unit. But in terms of actual engine performance, octane units at different levels vary greatly in size.

For example, expressed as *permissible increase in compression ratio* (bar chart below), one octane unit at the 90 level is 3.5 times as large as at the 60 level. At the 100 octane level, a unit is 6 times as large as at the 60 level. In other words, the steps going up the octane ladder get larger and larger.

Complete evaluation of the quality of gasoline requires measurement not only in terms of octane numbers but also in terms of scales based on those factors of engine performance dependent on antiknock quality. Three such scales are permissible compression ratio, thermal efficiency and power output. The three charts at right show the relationships between octane numbers at given levels and these engine-performance factors, as obtained on representative engines.

CHART 1. *This chart shows that the units going up the octane scale become larger and larger in terms of permissible increase in compression ratio.*



GOING UP THE OCTANE LADDER

Charts 2 and 3 at right show data obtained on engines as the compression ratio is varied.

Chart 2 shows that the *maximum permissible compression ratio* of an engine increases more rapidly than the octane number of the fuel. Chart 1 (lower left) also expresses this relationship.

Chart 3 shows the variation of engine *thermal efficiency* with fuel octane number as compression ratio is increased. Like permissible compression ratio, engine thermal efficiency increases more rapidly than fuel octane number.

Chart 4 shows the maximum power obtainable at fixed compression ratio from an engine in which increased antiknock quality is used to improve volumetric efficiency, as in supercharging. The power obtainable from a supercharged engine rises faster than the octane number of the fuel. (A similar relationship forms the basis of the Army-Navy Performance Number Scale, on which 100 performance number is equal to 100 octane number.)

All three charts show that in terms of potential engine performance, octane numbers get bigger and more valuable going up the scale.

The improvement of fuels to meet the steady average increase in compression ratio, designed each year into automobiles, requires a full understanding of all the potentialities of fuel quality. When reviewing the economics of gasoline production, refiners might profitably think not solely in terms of octane numbers but in terms of scales of antiknock quality based on the three factors of engine performance—maximum permissible compression ratio, thermal efficiency, and maximum power obtainable. Future messages will use these scales in discussing benefits from the addition of tetraethyllead to gasolines.

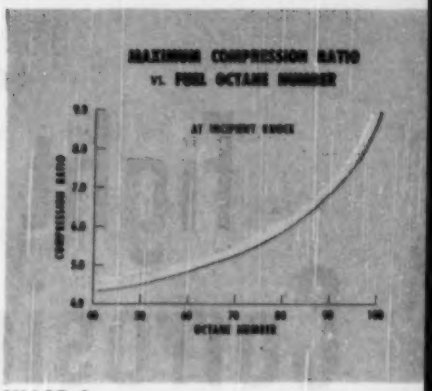


CHART 2

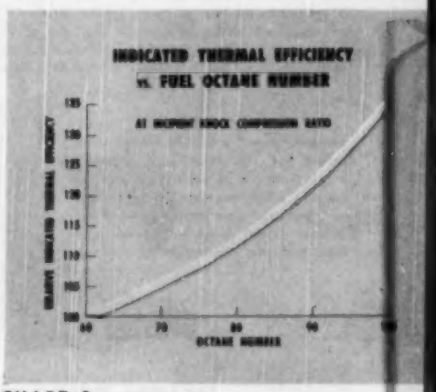


CHART 3

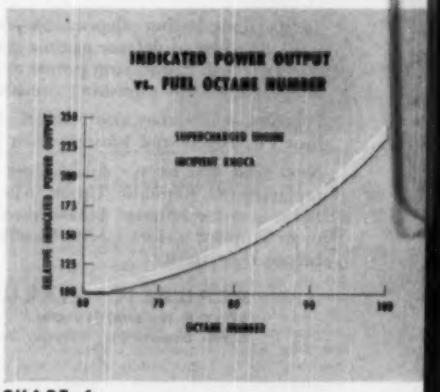


CHART 4

Since 1923—*continuous research to provide better antiknock service*

ETHYL CORPORATION
RESEARCH LABORATORIES

Detroit, Michigan
1600 West Eight Mile Road

San Bernardino, California
2600 Cajon Road

Fight Corrosion

...WITH THIS RUGGED STUD

Tough—long-lasting—dependable—Republic Upson Alloy Steel Studs are a first line of defense against corrosion. In addition they have the great strength and staying power to stay "on stream" despite blistering temperatures and punishing pressures.

Precision-made—they also turn off as freely as they go on—when lines, heat exchangers and blowers must be opened.

Next time you have a stud failure from whatever cause—make your replacements Republic Upson Alloy Steel Studs and reduce future failures to a minimum. Likewise—next time the matter of new equipment is up for action, specify these studs and head off corrosion worries before they start!

REPUBLIC STEEL CORPORATION
BOLT & NUT DIVISION • CLEVELAND 13, OHIO
Export Department: Chrysler Building, New York 17, New York

REPUBLIC *Upson Quality* **ALLOY STEEL STUDS**

Made from Alloy Steel—from the furnaces of Republic, world's leading alloy steel producer.

Other Republic Products Include Machine, Tank and Carriage Bolts—Lag Screws, Cap Screws and Rivets

AIRCO

YOUR SUPPLY DEPOT
for
OXYACETYLENE FLAME AND ELECTRIC ARC WELDING AND CUTTING EQUIPMENT AND SUPPLIES

AIRCO GASES AND CARBIDE

Airco Oxygen is produced and tested under the most rigid scientific procedures, and is guaranteed to be 99.5% pure in the cylinder. High purity assures maximum speed and economy in cutting, and greater efficiency in welding.

Airco Acetylene has been proved by use and test to be the most economical fuel gas for pipe welding and other flame welding operations.

Other Airco gases such as Nitrogen, Hydrogen, Carbon Dioxide and the rare gases Argon, Neon, Helium, Xenon, and Krypton (and mixtures thereof) for commercial and laboratory use are available through a nationwide distribution system. Nitrogen and Oxygen may be also obtained as a liquid and Carbon Dioxide in solid form.

National Carbide (in the red drum) assures the user of a high acetylene yield – better than 4.5 cu. ft. per lb. It is made from the finest available coke and limestone by the most modern manufacturing methods. It is evenly sized and dust-free. Available in five sizes in 25-lb. and 100-lb. drums, 2-lb. and 10-lb. cans.

OXYACETYLENE APPARATUS AND SUPPLIES

Airco No. 846 Welding, Heating and Cutting Outfit. This is the outfit for heavy-duty as well as light and medium day-by-day production welding and occasional cutting. The five tip assemblies will weld metals from the lightest gauge to the heaviest section. Other special purpose tips make possible additional profitable operations such as flame hardening, flame cleaning, silver brazing and the heating of large sections prior to welding. Also included in the outfit are two dual-stage regulators, wrench, goggles, spark lighter, and a special cutting attachment for cutting metals up to 1" thickness.

Airco Tensile and Bend Testing Machine. This machine permits rapid testing of weld specimens in the shop, laboratory, or on field operations. Guided bend tests, transverse tension, and longitudinal all-weld metal tension tests are quickly made with this compact Airco machine.

AIRCO HARDFACING ALLOYS add 2 to 25 times LONGER SERVICE LIFE to worn and new parts
Whatever your wear problem – heat, corrosion, impact or abrasion – Airco's New Hardfacing Alloys will give you the most effective solution. With one application of these wear-retarding materials, the service life of both worn and new parts is increased, in some cases, at least 25 times.

Airco Pipe Cutting and Beveling Machine. This portable flame cutting machine is the fastest, most economical means of preparing pipe for welding. It simultaneously cuts and bevels pipe to any angle. It is chain driven and turns around pipe or remains stationary as pipe is revolved. Airco also has available a full line of other portable and stationary shape and straight line oxyacetylene cutting machines.

ARC WELDING MACHINES, ELECTRODES AND ACCESSORIES

The Wilson "Yellow Jacket" is a ruggedly constructed, gasoline engine-driven generator that has proved ideal for field welding. Features include compactness, improved automatic idling device, close coupling of drive and generator. Made in 300 and 400 amp. sizes. Also available are 200 amp. Wasp and Hornet Specials with air-cooled engines.

The Wilson "Hornet," famous for its smooth, steady arc, easy regulation, and reliable service, is ideal for general purpose DC welding. Made in 200, 300, 400 amp. sizes.

The Wilson "Bumblebee" AC welders (indoor and "All-Weather" models) are supplied in 200, 300, 400 and 500 amp. sizes and other AC units in 750 and 1000 amp. sizes.

A complete line of shielded arc AC and DC electrodes. Airco No. 78E is ideal for DC all-position, general purpose welding where excellent physical qualities are needed. Airco No. 387 is recommended for single or multiple pass DC or AC welding on rusty work and where fit-up is poor. Airco No. 230 is a "top-notch" electrode for all-position AC welding.

Arc Welding accessories include helmets, holders, clamps, gloves, brushes, etc.

★For additional details on any of these products, please contact the nearest Air Reduction Magnolia office.

AIRCO **AIR REDUCTION MAGNOLIA COMPANY**

A Division of Air Reduction Company, Incorporated

Beaumont • Corpus Christi • Dallas • El Paso • Fort Worth • Hobbs
Houston • Oklahoma City • San Antonio • Shreveport • Tulsa • Wichita Falls

Southwestern Headquarters for Oxygen, Acetylene and Other Gases . . . Carbide . . . Gas Welding and Cutting Machines, Apparatus and Supplies . . . Arc Welders, Electrodes and Accessories

BUY . . . .

CALITE HEAT ENDURING CASTINGS

to

DEFINITE CHEMICAL AND PHYSICAL SPECIFICATIONS

This Will Assure Uniform Quality and Service

STANDARD SPECIFICATION NO. 10-38

Heat Enduring Castings
For Industrial Furnace Construction
Grade "F"

CHEMICAL COMPOSITION:

(a) The castings shall conform to the following requirements as to chemical composition:

	GRADE "F"
Chromium, per cent	25.0–28.0
Nickel, per cent	10.0–12.0
Manganese, per cent	0.50–1.25
Silicon, per cent	0.25–1.75
Sulphur, maximum per cent	0.05
Phosphorous, maximum per cent	0.05
Carbon	Within limits of Paragraph 4 (c)

(b) The chemical limits for all other added alloying elements, such as molybdenum, titanium and nitrogen, shall be specified by the manufacturer. The material shall conform therewith.

CREEP STRESS AND CERTIFICATE:

(a) The indicated creep rate of the material shall not exceed 1% in 10,000 hours when stressed by a tensile load not less than the following:

TEMP. °F.	STRESS PER SQ. IN. 1% CREEP IN 10,000 HOURS GRADE "F"
1400°	4200#
1500°	3700#
1600°	3200#
1700°	2600#
1800°	1950#

(b) Manufacturer shall submit standard creep data and residual physical properties made on material of his own manufacture and certified by an ACCREDITED LABORATORY. The chemical analysis of the creep test specimens shall be reported, including nitrogen content and any other special alloying elements.

TENSION TEST FOR DUCTILITY AFTER HEATING:

(a) Each heat shall conform to the following requirements as to tensile properties after the specimen has been subjected to a temperature of 1400° F. for 24 hours and furnace cooled to 400° F. Test shall be made at room temperature.

	GRADE "F"
Tensile Strength, min.lb./sq.in.	80,000
Yield Strength, min.lb./sq.in.	35,000
Elongation in 2", min. per cent	9.0

Copy of complete specification will be mailed upon request.

THE CALORIZING COMPANY

HEAT ENDURING AND CORROSION RESISTING METALS.
CALITE ALLOY CASTINGS — CALORIZED STEELS.

WILKINSBURG STATION **PITTSBURGH 21, PA.**

QUESTION:

What packings are resilient and flexible, but wear like metal?

ANSWER:

Garlock METAL FOIL Packings

COPPER GARLOCK 906—Pleated copper foil with asbestos core for steam, air or gases (except ammonia) and hot oils of low sulphur content, at temperatures up to 1000° F.

ALUMINUM GARLOCK 913—Pleated aluminum foil with asbestos core for hot oils at temperatures up to 1000° F.

LEAD GARLOCK 917—Pleated lead foil with asbestos core for steam, air, oil, water, ammonia or other gases at temperatures up to 550° F.

GARLOCK Metal Foil Packings are constructed of thin metal foil spirally wrapped around a fibrous center core. The durability of metal wearing surfaces in contact with the rod or shaft is thereby combined with the resiliency of a fibrous packing.

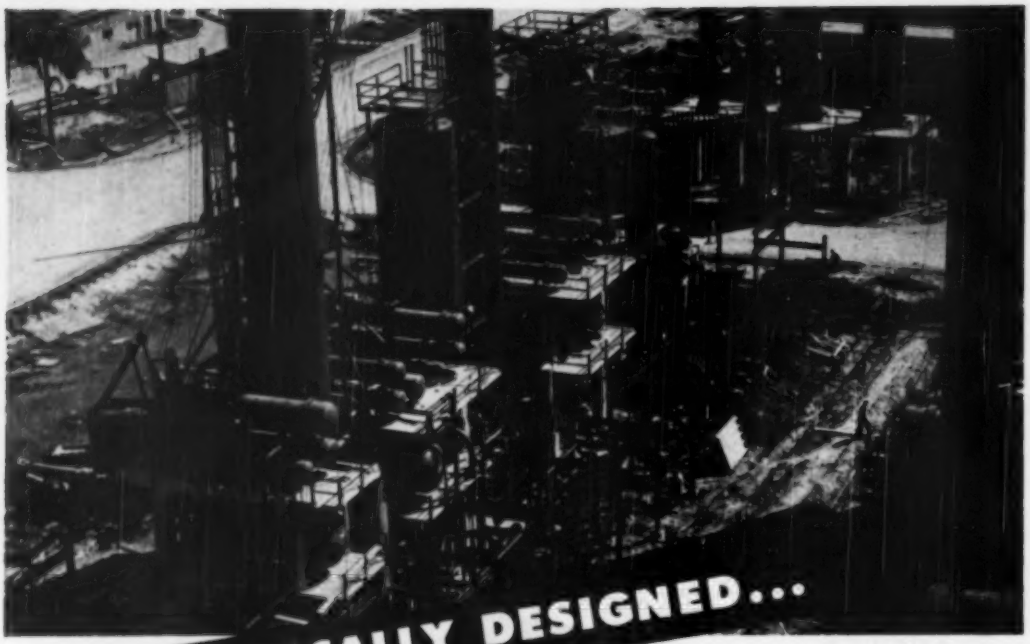
A patented, pleated foil construction used in several of these new Garlock packings imparts unusual flexibility to the packing and permits the forming of rings without undue distortion of the material. GARLOCK Metal Foil Packings are recommended for centrifugal or reciprocating pumps, compressors, engines, expansion joints, etc. Write for descriptive folder.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

Tulsa, Okla. Houston, Tex.
Los Angeles, Calif.

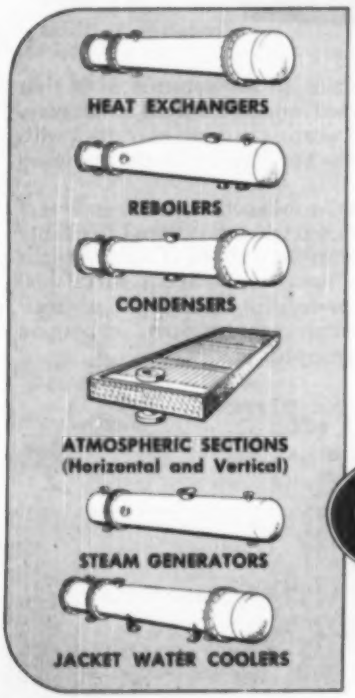
GARLOCK

PACKINGS, GASKETS AND OIL SEALS



SPECIFICALLY DESIGNED...

FOR THE REQUIREMENTS OF THE JOB!



EFCO HEAT TRANSFER EQUIPMENT

● EFCO engineers can supply you with any type of heat transfer equipment to meet your specifications. Reboilers, condensers, atmospheric sections, jacket water coolers, steam generators and heat exchangers, made by EFCO specialists, are sturdily constructed to give long trouble-free service. Ask an EFCO engineer. He will be glad to help you with your heat transfer problems.

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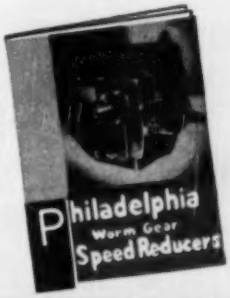

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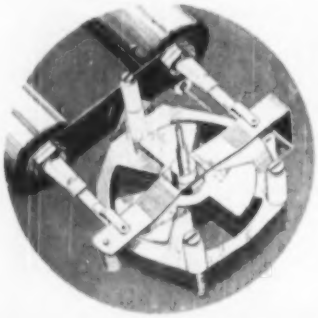

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A SERVICE ORGANIZATION

UP IN British Columbia a life saving club of an unusual nature was formed a little over a year ago. At this time, there are some eight to ten members, made up primarily of logging workers, though restricted to no one group of workers. Purpose of the Turtle Club: To encourage the wearing of head protection among all workers exposed to falling objects.

"Shell on Head, We're Not Dead"

The Turtle probably symbolizes self-protection more than any living thing and is certainly appropriate for this occasion. The only requirement for active membership is proof in the form of a printed application completed and signed by responsible people that the applicant's life was definitely saved by wearing a hard hat. Those qualifying will be presented with a lapel pin in the form of a turtle, and a scroll setting forth the history of their case.

So, at last, the men who have the common experience of having their lives saved by hard hat wearing are able to band together to demonstrate the necessity of head protection against the ever-present risk of overhead hazards. Eventually, the Turtle Club will become international in scope and memberships, as sponsors the world over are found.

The constitution and by-laws of the Turtle Club as drawn up by Rusty Rustmeyer, safety director of the Canadian Forest Products Co. Ltd., and Ralph Fuller of Fleck Brothers, Ltd., Vancouver, B. C., are being adopted without change.

Application blanks may be obtained from E. W. Bullard, E. D. Bullard Company, 275 Eighth Street, San Francisco 3. Complete information and a copy of the constitution and by-laws will be sent on request.

HERMAN W. Steinkraus, president of the Chamber of Commerce of the United States, quotes the Cleveland Plain Dealer's simple language explanation of basic facts connected with the public debt. This is the quotation:

Who Would Sign the Note?

"Will the reader pretend that he has an obscure neighbor by the name of Harry Truman? And will he pretend that neighbor Truman has decided he must borrow money, a decision which many of us ordinary folks have reached at times in the impetuous course of our lives?

"Neighbor Truman, going to retrench, steams into the bank to apply for a loan, and we are going to have the privilege of observing the transaction.

"'I want to borrow $500,' says our neighbor.

"'Do you have any debts at the present time?' inquires the banker.

"'Yes, sir,' says our neighbor, 'I owe the bank at this moment $28,500.'

"'What is your annual income, Mr. Truman?'

"'I have take-home pay to the amount of $3,750 a year,' says he.

"The banker 'h'ms.' He was at once suspicious as to how he could pay the old debt without $500 more being added, so he asked Mr. Truman, 'Do you think you will be able to save a large portion

Top of Page Photo—Night scene of Humble Oil & Refining Company's Opelousas, La., plant shows cooling tower on the right and stills, absorbers, and fractionators on left. The tall vessel on the extreme left is the desobutanizer.

Chemical section of one of the five Du Pont District Laboratories

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The laboratories provide a comprehensive service on problems involving gasoline quality. These include routine inspections, oxidation stability and TEL response. As a result of these studies, they can frequently recommend one or more additives, from the complete line of Du Pont Gasoline Additives, which will help you produce a better gasoline. There are also numerous case histories where Du Pont Technical Representatives have helped solve troublesome or costly refinery problems through the use of the proper additives at the right place in the refining operation.

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of your income this year and each succeeding year to reduce your indebtedness?'

"'No,' Neighbor Truman replies, 'my living expenses will be $4,250. I will be forced to spend more than I earn.'

"'Pardon me,' the startled banker interjects, 'do you mean that owing already an amount seven times more than you will take in during the year you are going to spend more than you earn?'

"'That's right,' says Neighbor Truman, 'You see, I must provide tuition at the private schools for my children; I must help a poor relative set up a new business in which he is going to lose money for a long time to come.'

"'Just what kind of business is that relative going to sink your money in,' the incredulous banker asks.

"'Why,' said Mr. Truman, 'he has got a wonderful humanitarian idea. He is going to sell milk to the Hottentots at a price they can afford to pay.'

"'Just those things won't eat up your whole income this year,' said the banker hopefully.

"'That isn't all,' said Mr. Truman, 'I am building security for my children by putting price supports under them. My boy sells newspapers at a nickel apiece, but I give him an extra nickel. My daughter makes lamp shades for $5, but I don't think it is a fair price, so I give her an extra $2 for each one she makes; besides, my wife wants a television set.'

"Here is a fellow who owes more than he can ever pay and still wants to borrow more, and boldly proclaims his intention of carrying out fantastic money-spending schemes. What will the banker do? Will he lend the new money? It is silly to ask the question.

"This scene is not fiction," the editorial continues, "it constitutes a faithful reproduction of the program set forth in regular solemnity by the President of the United States, Harry Truman. Multiply all figures by ten million, and you have the Truman budget, his plan of government, the Government's income, and the Government's debt.

"In this case, Congress is the banker. If it makes the loan, Truman's note will have to be signed by the taxpayers, which is all the people. Who, in their right mind, would sign such a note?"

Oil On The Waters

MAJOR postwar changes in world commerce are reflected in the makeup of shipping fleets. Although world trade as a whole has barely returned to prewar levels, petroleum shipments have increased tremendously. When construction in progress or on order is completed, merchant shipping tonnage will be 13 percent above prewar levels, almost entirely because of a 74 percent rise in tanker tonnage since 1939, according to the "Industrial Bulletin" of Arthur D. Little, Inc.

Including current construction, the world's tanker fleets total 31 million deadweight tons, of which about nine million are American. Tankers make up half the active U. S. merchant fleet, the world's largest. Great Britain, whose control of about a fifth of the world's shipping puts her second in total merchant tonnage, has about 20 percent in oil carriers. Britain's shipyards, which are turning out 45 percent of the world's new vessels, have a little more than half their tonnage of new construction in tankers. The smaller shipbuilding industry of the United States has about 90 percent of its tonnage on order in tank ships. These are mainly responsible for changing the low level of activity early in 1948 to the shipbuilding pace which made 1949 a record peacetime year.

Construction has now overcome the shortage of tankers which resulted immediately after the war from the rapid rise in the demand for oil, the Bulletin points out. Crude oil production abroad is at its highest level in history. Since 1948 the United States has been a net importer of oil, with gross imports of 640,000 barrels a day during 1949. In February, 1949, shipments of Middle Eastern crudes reached a peak of about 170,000 barrels a day, about as much as received from Venezuela, usually our principal foreign source. Virtually every other industrial nation, except Russia, has long depended on foreign supplies.

Europe, which once drew most of its supplies from the Western Hemisphere, mainly from the Caribbean area, is now taking its increased supplies of oil from the Persian Gulf ports. Before the war, imports from the West were at the rate of about 580,000 barrels a day; this has been cut almost in half and indications are for a continuing decline. The sterling areas attempt to obtain as much of their supplies as possible from wells controlled by British interests, leaving American controlled production to find markets elsewhere. An effort is being made, with the aid of Marshall Plan funds, to construct enough refining capacity in Europe to take care of her entire needs. This will be in the neighborhood of 1.25 million barrels a day, using chiefly Middle Eastern crudes. This oil has a price advantage over Venezuelan or Texas crudes not only in Europe, but also in Chile and Argentina, despite the longer haul from the Middle East. From Ras Tanura in the Persian Gulf to Southampton is 6200 miles, compared with 3900 from Puerto la Cruz, Ven. However, for tankers which can load at the eastern end of the Mediterranean from the pipelines bringing oil across Arabia (1100 miles) and Iraq (530 miles), the tanker journey is about 3000 miles shorter and the Suez Canal toll charges of 12.5 cents a barrel are avoided. From Ras Tanura to New York is 8300 miles, which limits a tanker to a little over six round trips a year, but even so, under some conditions Middle Eastern oil may be competitive with Venezuelan and Texas crudes in East Coast ports of the United States.

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Independents Help Keep Oil Industry Competitive

PAUL G. BLAZER
Ashland Oil & Refining Company, Ashland, Ky.

THE most serious problems of the oil industry pertain to its public relations and to its relationships with the various governmental agencies. Probably no other industry has so many contacts with the various levels of governmental authority—not even the closely regulated public utilities. Yet, probably no other industry is more grossly misunderstood than ours.

Unfortunately, the average person on the street seems to think that our industry is comprised of a few oil giants whose principal purpose is to maintain high prices and suppress competition.

Some of you may have been surprised to read a few days ago that the government has instituted an Anti-Trust suit against seven large oil companies on the Pacific Coast. They are accused of price stabilization and restriction of production of crude oil through voluntary conservation and proration. Some of the charges pertain to relations between the large companies and the independents.

Importance of Oil Suits

One of the principal purposes of this suit is to divorce wholesale and retail marketing of petroleum products. This divorcement action should not come as a surprise. Some marketers have encouraged it—in my opinion mistakenly. The Anti-Trust Division of the Department of Justice has been pointing in that direction for many years. It will be recalled that the meat packers are prohibited from engaging in retailing. One of the issues in the highly publicized A. & P. suit has been an effort to prohibit A. & P. from engaging in the processing of foods. The motion picture companies have accepted an anti-trust consent decree splitting their studio and theatre operations.

This new move against the oil industry, however, is much more serious than the action against the other industries. Integration in our industry is far more complex and involves many more wholesaling units than heretofore have been affected by similar anti-trust action. The author can't help but believe that the Anti-Trust Division lacks understanding of the economics of petroleum marketing. There is no sharp line between the wholesaling and retailing of petroleum products. Literally thousands of companies and individuals engage, to a greater or lesser degree, in both operations. No useful purpose would be served. The cost of doing business would be increased greatly and prices to consumer would have to be raised. The oil industry is like an automobile assembly line which cannot be broken without loss of efficiency and resulting higher costs—with benefits to no one.

The sincerity of purpose of the Anti-Trust Division is not questioned here. However, they simply don't have the "facts of life" pertaining to our industry, and probably we are more to blame than anyone else. We have been so busy competing with each other that we have neglected our public and governmental relations.

There are more than 1600 independent distributors of petroleum products in New York state. Although one of the independents in the oil industry for more than 30 years, the author would have estimated about 500 and the average layman likely would have guessed the number at less than 100.

The major oil companies need these independent marketers. That applies equally to all branches of the oil industry from production, straight through refining, transportation and marketing. The 20 or 30 so-called major oil companies would be comparatively helpless if haled into court, or even if brought before the bar of public opinion. The misconceptions concerning the oil industry are too deep-seated. Their case would be prejudiced before they start. Whether we like to admit it or not, corporate bigness is in itself an indictment in the eyes of a large segment of the American public. Many people have far more confidence in what a little man says than in the statements of the leaders of industry. There is no justification for that prejudice, but surely it exists.

Many people born long after the dissolution decree of 1911 still think in terms of the old Standard Oil trust. The shades of Ida Tarbell still are walking, even though the sins of the Standard Oil trust, alleged so convincingly in her book, have not been practiced during the years the author has been in the industry. Many people believe the mere fact that independents can prosper in the face of competition from the oil giants is evidence of some unholy alliance; they believe small operators exist only through sufferance; and that there is no real competition between the big companies, as evidenced by the fact that when one large company changes prices the others make similar changes.

Seriously, there is too much uniformity of pricing in the oil industry—a uniformity which results not from collusion but from a foolish competitive fear that if another company is permitted to have a lower price it will take all the customers. Uniformity of pricing, regardless of the reason, appears to be the cause of much of the suspicion on the part of the Anti-Trust Division. Those basic industries where competition is exceedingly keen, resulting in identical prices, have been the targets of the Department of Justice. It would be better for us to have greater variation in prices, even if we lose a few customers to competitors, than to continue to risk governmental prosecution and possibly lose the right to compete as a free enterprise industry. We in our industry know that the tendency toward uniform prices is not because of collusion nor lack of competition, but because of too much competition.

An Historic Difference

It might be thought, also, that there is collusion in the quality of our products. If one company raises the octanes of its gasoline, we all follow like a bunch of sheep even though the need for raising octanes may be debatable. The cars in the Middle West are not different from those operating in New York, yet there has been an historic difference in the specifications of gasoline sold in the two areas. We have heard no complaints from the public on the quality of gasoline sold in Chicago,

Indianapolis or St. Louis as contrasted with Buffalo, Syracuse and Albany, yet it costs millions of dollars more per year to produce the quality of gasoline sold in New York than the gasoline sold in the Middle West. The oil industry is not rich enough to absorb that extravagance; the extra cost has to be passed on to the public which, in the case of the owners of 90 percent of the cars on the road today, has received nothing of value for the extra expenditure.

The extravagant advertising claims for various brands of gasoline, between which the public can detect little or no difference, afford ground for skepticism; and the claims for today's new gasolines, which in the experience of most people perform no better than the gasolines purchased last year, certainly do not engender confidence on the part of our customers. Again it might be said, a large part of the misunderstanding and criticism of our industry stems from the competitive practices within the industry.

Probably no large oil company would be permitted by its competitors to offer its gasoline, generally, at a lower price even though that gasoline were known in the industry to be of a lower octane grade, with a resulting lower cost of manufacture. We spend millions for higher octanes and then by our competitive practices assume that the public can't tell the difference. That doesn't make sense. It wouldn't happen in most industries; it's not good sales psychology.

Some years ago an oil company whose products enjoy an outstanding acceptance in the East, and which appears to occupy a unique position in setting the quality styles for its competitors, introduced its gasoline into a certain area of the Middle West. For some unexplainable reason, it didn't meet with its usual acceptance from the public. In an effort to increase sales, the price of this gasoline was dropped 2 cents per gallon. Had the price of competitive gasolines been dropped to meet it, as usually would have been the case, the public might have taken notice and the newcomer might have received some free publicity. However, the public took no note of the price differential except, possibly, to decide that it must be an inferior grade of gasoline that had to be sold at a cut price.

The lower price was discontinued after a year or two and it can safely be said that in no other area has that popular brand of gasoline fared so poorly. In fact, the company has since given up many of its stations and its gallonage per outlet doubtless continues to be the lowest of any in the territory. Apparently their sales are still discredited by their early cut price. The public's reactions to our pricing policies are not always what the industry would expect.

Recently in Indianapolis, where an old fashioned local gasoline price war was in progress, the stations of one of the best known so-called "price cutters" was maintaining its prices at a higher level than the major brands. Its stations appeared to be doing their usual volume and later the owners advised that although the price war lasted for many weeks they maintained their volume of business in spite of the lower prices of their larger competitors.

The oil industry makes a mistake in thinking disparagingly of so-called price-cutters who try to undersell the market. Within reasonable limits, they are good for the industry. They likely are our best protection against governmental investigation. They tend to keep our prices down and force us to be more efficient. Besides the most ardent price-cutter today may be a most respected member of the industry tomorrow. Possibly 75 years ago John D. Rockefeller asked Cincinnati Oil Works to become the agent for Standard Oil products in Cincinnati. The owner wrote back and said he was unwilling to take the agency because he had heard that Standard Oil was a price-cutter.

"Appropriate Financial Strength"

Although there appears to be no need for such uniformity of pricing and uniformity of quality as exists in the oil industry, we would not imply that price cutting is a virtue, unless supported by low costs and appropriate financial strength. Too often the lowest prices are offered by small outfits who can least afford them; by people who start trouble and then complain to a governmental agency when they begin to be hurt by competitive conditions to which they may have been the principal contributors.

Under present conditions it takes the action of only one important marketer to depress the market to an unprofitable level, a level which causes the public to think that the normal price must have been too high. To restore markets to reasonable levels, some degree of co-operation is required and competitors may be tempted to have conversations which might be justified morally but which wouldn't stand the scrutiny of the Anti-Trust Division.

The position of the major oil companies would be less vulnerable to governmental attack if there were more reasonably large independent distributors marketing gasoline under their local brand names. It should not be necessary to associate a local brand name with either lower quality or a cut price. The principal strength of the major oil companies in marketing their products is not their brand names or their advertising campaigns, but the attractive appearance and superior service of their stations. There are many areas in the Middle West where a local independent brand of gasoline marketed at the so-called normal price through attractive, well-manned service stations, carries the number one position as regards gallonage.

There are still plenty of opportunities for the marketing of petroleum products at prices that are higher than the generally prevailing level. A large percentage of the people are influenced more by service and salesmen than by price.

There are a great many people who are happiest when they know they are paying the highest price and getting a good product along with the best service. On the other hand, in those localities where the public has become unduly price-conscious, it is entirely the fault of the oil industry; it takes more than a few cut-price marketers in an area to bring about that situation. Often the trouble results from price wars between major oil companies augmented by ill feeling between their local managers. In my opinion, the same fundamental pricing policies are applicable to fuel oil marketing as to gasoline, although possibly to a somewhat lesser degree.

There are just as many opportunities for the independents in the future as at any time in the past. In fact, some of the trends in business today are working to the advantage of individual enterprise as contrasted with large scale operations. Tax laws which already penalize larger companies will be even more favorable for small business in the future. Labor relations are likely to be better in smaller operations. Unionization, which thrives on driving a wedge between a company and its employes, is not conducive to the good salesmanship and successful merchandising needed in our business. In this field, the smaller operators have a distinct advantage. It is becoming increasingly difficult for large corporations to retain the friendly attitude of their employes in the face of propaganda directed at large employers and big business in general.

Some of the largest oil companies appear to recognize the wisdom of welcoming strong independent competition. Most of them, however, give only "lip service" to that idea. For example, the independent marketers do not get a fair break in the common carrier pipe lines owned by the major companies—nor in the exchange of products and terminal facilities. Those are some of the complaints in the most recent anti-trust suit. All that the independents need is an "even break."

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This New Esso Refinery of the Anglo-American Oil Company at Fawley, England, now being built by Foster Wheeler, is scheduled for operation early in 1952. It will be the largest refinery in Europe, with a crude charge capacity of 110,000 bbl day.

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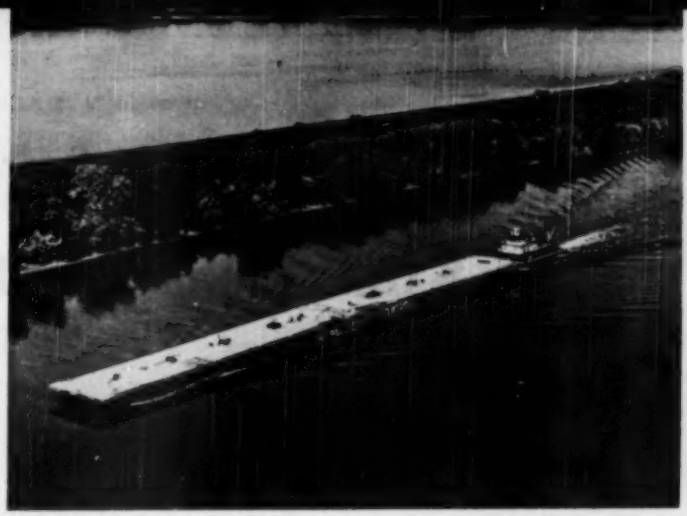
government are involved. It is not just an accident that governmental attitude toward farmers is the exact opposite from its attitude toward those industries which appear to be dominated by a few large corporations. The government supports and guarantees the prices for farm products but complains about the prevailing prices for steel, gasoline and many other commodities. Relatively, prices for farm products have been much better in recent years than in the oil industry. The stocks of many of the larger oil companies are selling for less today than 20 or 25 years ago and the dividends paid in the intervening years usually have been modest. Generally speaking, investors in oil have not fared so well as in most other industries. Thus, it is for some reason other than excessive profits that the government is showing such keen interest in petroleum prices.

Some of our trouble comes from pressure groups within the industry who place greater reliance on their political influence than in their competitive position in the industry. Especially, we should all deplore the recent effort toward a political alliance between certain independent oil producers, coal operators, railroads and labor unions aimed against the importation of foreign crude oil. Such reliance on politics and political alliances to gain competitive economic advantage presents a real threat to all of us.

Congress already is too conscious of the oil industry for our good. Particularly in the production branch of the industry, state conservation agencies have been used to promote an unhealthy price-rigidity which does not permit reasonable reactions to variations in supply and demand. In so doing we are encouraging the kind of governmental interference and regulation of our industry which eventually may bring on price controls and reduce us to the status of a public utility.

There is no reason why the production branch of the oil industry shouldn't be willing to bear its fair share of the price adjustments characteristic of changes in supply and demand in a free market. The coal industry and the railroads, which are pricing themselves out of their markets, are not the kind of allies that one would pick for the oil industry in the face of our new competition from greatly increased supplies of natural gas.

Whether prices go up or down, whether supplies are plentiful or scarce, regardless of whether crude oil or refined products are involved—in the eyes of professional calamity howlers the oil industry is always about to go bankrupt unless some program or regulation under governmental auspices is adopted immediately. Either the courts or the legislatures or bureaus or commissions are asked to work a miracle to prevent some imaginary disaster.



LUBE STOCKS TRANSPORT—Twin barge fleets to be used for transporting lubricating oil stocks from the Citcon Corporation plant, Lake Charles, La., to the new $4-million blending plant which Cities Service Oil Company is building at Cicero, Ill., are shown above in the Gulf Intracoastal Canal. Built by Dravo Corporation, Pittsburgh, the new type integrated barges carrying a total of about 33,300 barrels can complete the 3400 miles in an average of 21 days.

The only thing that verges on the miraculous is not that the industry escapes disaster but that it has for so long escaped complete governmental regulation and the loss of its freedom to compete. Having escaped from a real shortage, we now witness the spectacle of a group in the oil industry seeking to bar imports by governmental authority in order to create, market-wise at least, the very shortages from which we have so recently delivered ourselves. Improved technology, lower costs, better quality, coupled with a freedom to expand and compete has always enabled this industry to translate a surplus into a wider market. For the future I am confident that we will never be captured by the government from the outside; if we lose our freedom it will only come from the misguided efforts, however well intentioned, of segments of our own industry running to the government for help and thereby delivering themselves into governmental hands.

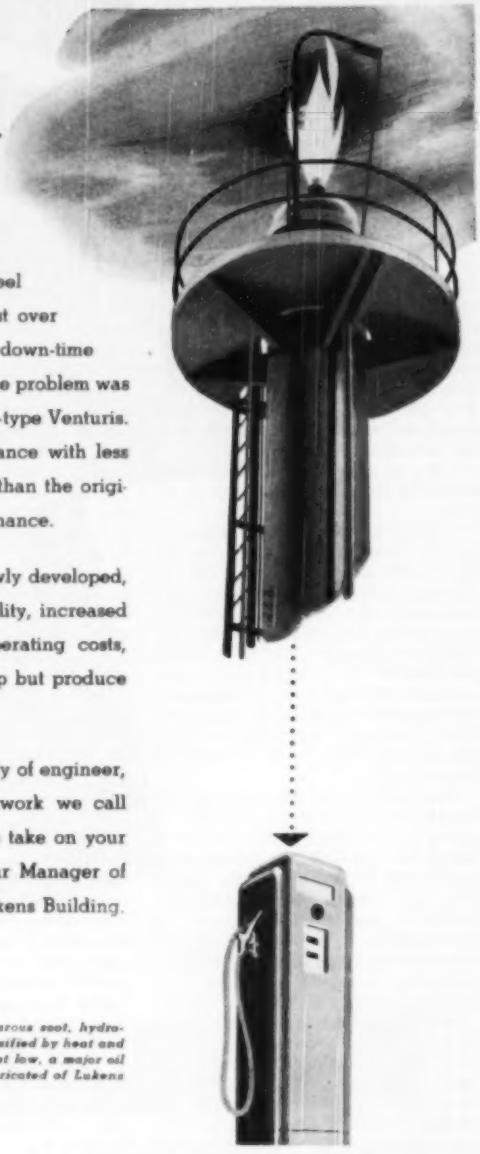
After spending considerable time recently with one of the leaders in the metropolitan distribution of natural gas, the author is less fearful concerning the extent that fuel oil may lose its important position in household heating. Losses to gas will be more than offset by gains at the expense of coal. Again, the competitive advantage will lie not so much in the matter of price as in the relative convenience of the different kinds of fuel and the salesmanship and service with which we promote our business.

There is no substitute for salesmanship. The most encouraging thing about the oil industry is that its salesmanship is still dominant—as is usually the case in an expanding industry. The independents are the best salesmen in the oil industry. They have to be. Salesmanship is needed now more than ever before. No longer is there a shortage of crude oil, or refining capacity, or of transportation; the only shortage we have today is a shortage of customers. It is a healthy, encouraging situation. It is only when industries have lost confidence in their salesmanship and have attempted to rely on governmental hamstringing of their competitors, as has characterized the attitudes of the railroads toward the trucks, or when industries lose confidence in their competitive position and try through artificialities to defeat the laws of supply and demand, that they cease to go forward.

Independents do our share to perpetuate the oil industry as a free enterprise. We have certain responsibilities to the oil industry and to the public; we have opportunities for service that can be fulfilled better by us than by the larger companies. There are many of us and few of them. We must not underestimate either our importance or our obligations. There is a public relations job to be done. We can do it better than the big oil companies. We must all recognize our place in the over-all picture in order that we may know our legitimate objectives and proceed to accomplish them in a way which will reflect credit on our industry in particular and all industry in general. Let's make sure that as independents we are doing everything possible to perpetuate our great industry along the lines of competitive free enterprise.

ONE OF A SERIES DEMONSTRATING APPLIED LUKENOMICS

How to Keep a Flare Tip in Operation 3 Years and Save Thousands of Dollars



In flaring off corrosive waste gases from deep-well sour crudes, a mid-west refinery had to replace steel stack tips every six months. Each replacement cost over $2,000 in steeplejack labor alone—to say nothing of down-time and equipment expense. The economic solution to the problem was special design inconel-clad steel stack tips with new-type Venturis. The modern tips have the needed corrosion-resistance with less weight . . . average over three years' more service than the original design . . . save thousands of dollars in maintenance.

Your operations, too, can surely be improved by newly developed, more efficient processes and equipment. Better quality, increased production, economical maintenance, reduced operating costs, longer equipment life are advantages that can't help but produce a more profitable and saleable product.

Behind all such advances is the cooperative ingenuity of engineer, designer, fabricator, materials supplier. This teamwork we call *Lukenomics*. There's a Lukenomics team eager to take on your equipment problems. Tell us about them. Write our Manager of Marketing Service, Lukens Steel Company, 404 Lukens Building. Coatesville, Pa.

LUKENS

LUKENS STEEL COMPANY

To eliminate corrosive attack from sulfurous soot, hydrochloric acid and organic chlorides, intensified by heat and weathering, and to keep weight and cost low, a major oil company now uses flare stack tips fabricated of Lukens Inconel-Clad Steel.

BETTER PRODUCTS FOR BETTER EQUIPMENT

Refinery and Other Plant Construction

Leduc Gas Conservation Plant Opened by Imperial

Several hundred barrels of natural gasoline will be recovered daily in Imperial Oil Limited's Leduc, Canada gas conservation plant, officially opened last month. Extractions will be made from approximately 13 million cubic feet of Leduc-Woodbend natural gas. Other products produced from the $5.5 million system will be propane and butane.

About 90 percent of the plant's production will be dry gas for domestic or commercial demand.

Kansas Refinery Additions

Shallow Water Refining Company has completed construction of a 1250-barrel-per-day Perco reforming unit at the Garden City, Kans., refinery. Plans are being drawn for a new polymerization unit, construction of which is scheduled to start September 1.

Richfield Oil Completes Cuyama Valley Project Gas

Richfield Oil Corporation has completed and put in operation its second natural gas processing plant in the Cuyama Valley, Calif. It will handle 30 million cubic feet of gas daily, extracting natural gasoline, butane, and propane. The residue dry gas will be forced back underground.

This plant together with the one completed last October, represent, with gathering facilities, a capital investment of about $9.6 million.

Socony-Vacuum Completes East St. Louis Program

An extensive modernization program was completed May 31 at the East St. Louis, Ill., refinery of the Socony-Vacuum Oil Company, Inc. Four main units were involved, partly replacing equipment previously in use. They include a new 17,000-barrel distillation tower for primary handling of crude oil, and a 20,000-barrel gasoline-treating unit to remove sulphur compounds from refined products.

Obsolete thermal cracking and coking units were replaced. The thermal unit has a daily capacity of 2800 barrels of naphtha. It also has a capacity of 3000 barrels daily for further refining of charge stock drawn from the two existing catalytic cracking units for production of gasoline and heavy fuel.

The coking unit can produce 240 tons of coke per day.

Charles P. Baker, refinery manager, said improvements will mean an increase of about 50 percent in the refinery's capacity and a jump in thruput from 21,000 to 30,000 barrels crude daily.

Gasoline capacity alone is raised from 462,000 gallons daily to 756,000 gallons, using modern Thermofor Catalytic Cracking and Houdry Catalytic Cracking processes. An alkylation unit installed during World War II will be put back in operation late this year in conjunction with this equipment.

Distillate fuel oil capacity was raised from 200,000 gallons daily to 250,000.

THE BOXSCORE, starting below, is an industry-wide service which can be made more complete and serviceable if subscribers will remember to 1) send in data (as called for in column headings) on projects not listed; 2) furnish details which are missing in any item in the current tabulation and 3) report from time to time on projects of which they may have knowledge. Address Editor, Petroleum Refiner, Box 2608, Houston 1, Texas.

MONTHLY TABULATION OF REFINERY AND OTHER PLANT CONSTRUCTION

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
EAST									
Calif. Refg. Co.	Barber, N. J.	Crd. Cat. Crk., Reformer, Alkylation Crude Units	25,000 bbls. 10,000 bbls. 5,000 bbls. 50,000 bbls.		Under Constr.	Jan., 1951	Houdry U.O.P. Kellogg	Houdry, Braun Braun Kellogg Braun	Braun Braun Kellogg Braun
		Boiler Plants	300,000 lbs./hr.					Braun	Braun
Calif. Refg. Co.	Barber, N.J.	3 Gaso. Trtng., Lead Sulfide Sweetening Plt., Reagent Plt.			Contracted			Cat. Constr.	Cat. Constr.
E. I. Dupont	Parkersburg, W. Va.	Tetrafluoroethylene Resin Plant			Under Constr.	Summer, 1950			
Esso Standard Oil Co.	Richmond, Va.	Benzene Bottling Plt.	3,500 gals	$70,000	Completed			Staff	Howard-Mitchell
Esso Standard Oil	Bayonne, N.J.	Steam Boilers	400,000 lbs. /hr		Completed			S.O.D., Day & Zimmerman	S.O.D. & Zimmerman
Freeport Sulphur Co.	Westville, N.J.	Sulfur Recovery	40 tons		Under Constr.	1950			Girdler
*Kendall Refg. Co.	Bradford, Pa.	Platforming Unit	1,500 bbls		Contracted	Late 1950		U.O.P.	U.O.P.
*Mathieson Hydrocarbon Chemical Corp.	Brandenburg, Ky.	Chemical Plt.		$17 million	Contracted	End 1951			
*The Pennzoil Co.	Rouseville, Pa.	Propane-Deresin, Resin-Fract.	1,730 bbls.		Designing	End 1950		Kellogg	Kellogg
Socony-Vacuum Oil Co.	Paulsboro, N.J.	Propane Deasph.	5,950 bbls.		Under Constr.	2nd Qtr., 1950	Juik	Badger	Badger
Socony-Vacuum	Buffalo, N.Y.	Houdry to TCC	13,000 bbls.		Under Constr.	Late Fall, 1950	Socony-Vacuum		
Socony-Vacuum	Brooklyn, N.Y.	Houdry to TCC	15,000 bbls.		Under Constr.	Late Fall, 1950	Socony-Vacuum		
L. Sonneborn Sons	Petrolia, Pa.	Antipollution, Acid		$450,000	Under Constr.	2nd Qtr., 1950		Chemico, Knowles	Kreo & Wise, Chemico
*Tennessee Gas Transmission Co.	Greensburg, *Ky.	Stripping Plt.	600,000 mcf gas	$12 million	Contracted	Summer, 1951		Staff	Staff
United Refining Co.	Warren, Pa.	Lab. Steam Gen	60,000 lbs./hr.			4th Qtr., 1950			Union Iron Wks.
MID-CONTINENT									
Cities, Service, Del.	Cinero, Ill.	Compound Plt.	1,200 bbls.	$4 million	Under Constr.	July, 1950			Sellitt
Consolidated Gas Utilities Corp.	Cement, Okla.	Compr. Sta.	40,000 mcf		Under Constr.	2nd Qtr., 1950		Drumer	Drumer U.O.P., Brown & Lisa
Deep Rock Oil Corp.	Cushing, Okla.	Cat. Cracker	5,000 bbls.		Under Constr.	Spring, 1950		U.O.P.	J. & L. Constr.
The Derby Oil Co.	Wichita, Kans.	Cat. Crk. Change			Planning				
Dewese Oil Co.	Weston, Ohio	Lube Filtering	250 bbls.	$15,000	Under Constr.	Spring, 1950		Staff	Staff
Indiana Farm Bureau Cooperative Assn.	Mt. Vernon, Ind.	Fluid Cat. Cr.	4,000 bbls.		Under Constr.	1951		U.O.P.	Staff
Indiana Farm Bureau	Mt. Vernon, Ind.	Gas Concen.	3,500 bbls.		Under Constr.	1951			U.O.P.
Indiana Farm Bureau	Mt. Vernon, Ind.	Vacuum Uni	900 bbls.		Under Constr.	1951			U.O.P.
Magnolia Pet. Co.	Chitwood, Okla.	Compr. Plt	24,750 mcf		Completed			Staff, Constr. Service	Delta Constr. Service
Midland Co-Op. Wholesale Co.	McPherson, Kans.	Expansion	122,000 bbls.	$4 million	Planned				
Mississippi River Fuel Co.	Fredericktown, Ark.	Comp. Sta.	4,000 hp.		Under Constr.	June, 1950		Ref. Maint.	Ref. Maint.

REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
National Co-Op. Refinery Assn.	McPherson, Kans.	Polymerization, Fluid Cat. Crk., Addl Teakage, Utilities	†22,000 bbls.	$2 million	Under Constr.	.....	U.O.P.	Ref. Eng.	Ref. Eng.
Northern Nat. Gas	Sublette, Kans.	Gasoline Plant	265,000 mcf	.....	Completed	.....	.....	.....	Pritchard Poling & Bacon
The Ohio Oil Co.	Lima, Ohio	Ref. Prdts Term.	200,000 gals.	.....	Under Constr.	June, 1950	.....	.....	.....
Oklahoma Refg. Co.	Seminole, Okla.	Refinery	200 bbls	$40,000	.....	.....	.....	Lummus	Lummus
Pan-Am Southern Corp.	El Dorado, Ark.	Delayed Coke Water Cooling Tower, Steam Gen. Boiler, Coke & Loading	6,300 bbls.	.....	Planning	Oct., 1950	.....	.....	.....
Peco Corp.	Blue Island, Ill.	Houdry, Cat. Crk., LPG Recov.	5,000 bbls.	$400,000	Under Constr.	3rd Qtr., 1950	Houdry	Houdry	Clarke, Cat. Constr.
Petroleum Specialties, Inc.	Flat Rock, Mich.	Cat. Cracker	3,000 bbls.	$2 million	Planning	.....	.....	.....	.....
Phillips Petroleum	Okmulgee, Okla.	Cat. Poly Unit	.....	.....	Under Constr.	June, 1950	.....	Staff	Staff
Phillips Pet., et al.	Edmond, Okla.	Add Nat. Gaso Plant	60,000 mcf	.....	Under Constr.	June, 1950	.....	.....	Ref. Maint.
The Shallow Water Refining Co.	Shallow Water, Kansas	Reforming Unit	1,400 bbls.	$225,000	Completed	.....	Perco	Koch Eng.	Koch Eng.
Shell Oil Co.	Elk City, field Okla.	Gas Extrct. Plt.	100,000 mcf gas	.....	Contracted	End 1950	.....	Ref. Maint.	Ref. Maint.
Socony-Vacuum	Augusta, Kans.	Houdry Conversion to T.C.C.	15,000 bbls.	.....	Under Constr.	End 1950	Socony-Vacuum	.....	.....
Socony-Vacuum	Trenton, Mich.	Houdry Conversion to T.C.C.	15,000 bbls.	.....	Under Constr.	End 1950	Socony-Vacuum	.....	Braun
Standard (Ohio)	Cleveland, Ohio	Houdry to TCC	18,000 bbls.	$4 million	Under Constr.	Nov., 1950	Socony-Vac.	Boahtel Lummus	Boahtel Lummus
Standard (Ohio)	Lima, Ohio	Clay Contact	2,400 bbls.	$1 million	Under Constr.	Mid., 1950	.....	Staff	Hammond
Standard (Ohio)	Lima, Ohio	Inc. Tank. Cap.	215,000 bbls.	$240,000	Under Constr.	Mid., 1950	.....	Lummus	Lummus
Standard (Ohio)	Lima, Ohio	Furfural Unit	4,500 bbls.	$13 million	Under Constr.	Mid 1950	Texaco	Lummus	Lummus
Standard (Ohio)	Lima, Ohio	Solvent Dewax.	3,500 bbls.	$4.5 million	Under Constr.	Mid 1950	Texaco	Lummus	Lummus
Standard (Ohio)	Lima, Ohio	Vacuum Unit	9,000 bbls.	$1 million	Under Constr.	Mid. 1950	.....	Kellogg	Kellogg
Standard (Ohio)	Lima, Ohio	Propane, Deasph.	800 bbls.	$1 million	Under Constr.	Mid. 1950	.....	Foster Wheeler, Kellogg	Foster Wheeler, Kellogg
The Texas Co.	Lawrenceville, Ill.	Expand Refinery	†20,000 bbls.	.....	Under Constr.	April, 1951	.....	.....	Process Eng
Tide Water Associated Oil Co.	Drumright, Okla.	Houdriflow Unit Cat. Cracker	4,500 bbls.	.....	Completed	.....	Houdry	.....	.....
U.S. Dept. of Interior	Louisiana, Mo.	Demonstration oil-from-coal Desalting	80 bbls.	$5 million	Under Constr.	June, 1950	.....	Koppers	Koppers
Vickers Petroleum	Potwin, Kans.	.....	6,000 bbls.	.....	Under Constr.	June, 1950	.....	.....	.....
SOUTHWEST									
Alba Refg. Co.	Alba, Texas	Asphalt Refining	2,000 bbls	$150,000	Under Constr.	Spring, 1950	.....	.....	.....
*Barnsdall Oil Co., Op	Scurry Co., Tex.	Nat. Gaso. Plt.	50,000 mcf gas	$6.5 million	Considering	Feb., 1951	.....	.....	.....
Carthage Hydrocol, Inc.	Brownsville, Texas	Hydrocol	87,000 mcf	.....	Under Constr.	Spring, 1950	Hydro-Res., Inc. Texaco	McKee, Hydro-Res., Inc.	McKee
Del Rey Petroleum Co.	Chesterville, Tex.	Pressure Absorption Plant	25,000 mcf	.....	Under Constr.	.....	.....	O. L. Olson	Ole Olson
Dow Chemical Co.	Freeport, Texas	Ammonia Plant	100 tons	$5 million	Planning	Late 1950	.....	.....	Austin
El Paso Natural Gas	Crane County, Texas	Compressor Sta.	4,400 hp.	$1.27 million	Under Constr.	June, 1950	.....	Staff	Staff
E. I. DuPont de Nemours Co., Inc.	Victoria, Texas	Chemical Intermediate for Nylon	.....	.....	Design	Early 1951	.....	Staff	Staff
Esso Standard Oil Co.	Baton Rouge, La.	Main Office, Cafeteria, Crude Desalting Unit	.....	.....	Under Constr.	June, 1950	.....	Bodman & Murell, Staff	Staff, Harris
Fullerton Oil Co.	Snyder, Texas	Refrig. Nat. Gaso. Plt.	40,000 mcf	.....	Under Constr.	July, 1950	.....	.....	Hudson
Humble Oil & R.	Baytown, Texas	Roof Replacing of Butyl Bldg.	.....	.....	Under Constr.	Aug., 1950	.....	Staff	Telepsen
Humble Oil & R.	Baytown, Texas	Marl. Facilities	.....	$1 million	Projected	.....	.....	.....	.....
Humble Oil & R.	Jourdanton Field, Texas	Gasoline Plant	26,000 mcf	.....	Under Constr.	July, 1950	.....	.....	Hudson
Humble Oil & R.	Baytown, Texas	Research Bldg.	.....	.....	Under Constr.	Aug., 1950	.....	Voorhees-Walker Ferguson	Knutson Bellows
Humble Oil & R.	Baytown, Texas	Mech. Maint. Bldg.	.....	.....	Under Constr.	Oct., 1950	.....	.....	.....
Magnolia Pet.	Beaumont, Tex.	Thermofor Cat. Cracker	15,000 bbls.	.....	.....	1950	.....	.....	.....
Magnolia Pet. Co.	Beaumont, Tex.	Two Houdry's to T.C.C.	30,000 bbls.	.....	Authorized	Late 1950	.....	.....	Lummus
Magnolia Pet. (Operator) et al.	Lolita-La Ward, Jackson County Texas	Comp. Sta.	15,000 mcf	.....	Completed	.....	.....	West	West
Mathieson Chem. Co., McMurray Refining Co.	Pasadena, Texas Tyler, Texas	Fertilizer Plt. Fluid Cat Cracker, Gas-Conc., Feed Prep. & Cycle-Oil Crk.	5,000 bbls.	.....	Under Constr. Planned	1950 Fall, 1950	.....	Owner U.O.P.	U.O.P.
North American Oil Consolidated & Ungren & Frazier	Bartlett Field, Jones County,	Gaso. Plt., Gas Injection Facilities	.....	.....	Planning	.....	.....	.....	.....
Pan Am. Ref.	Texas City, Tex.	Desulfo Unit	.....	$25,000	Completed	.....	.....	Telepsen Ferguson	Telepsen Ferguson
Pan Am. Ref.	Texas City, Tex.	Lab., Pilot Plt. Additions	.....	.....	Completed	.....	.....	.....	.....
*Phillips Pet.	Phillips, Texas	Cat. Cracker	20,000 bbls.	.....	Planning	Aug., 1951	.....	.....	.....
Pontiac Refining Co. & Chicago Corp.	Corpus Christi, Texas	Ref. Petro-chem. Plt.	5,000 bbls. gaso., 170,000 bbls. ethylene glycol, 3,000 lbs. ethylene	$15 million	Design, Planning	Mid., 1951	.....	.....	.....
The Pure Oil Co.	Dollarhide, Andrews Co., Tex	Nat. Gaso. Plt.	22,000 mcf	$6 million	Under Constr.	July, 1950	.....	.....	Hudson
Shamrock Oil & Gas Co.	Sunray, Texas	Houdri. Cat. Crk.	5,900 bbls.	.....	Under Constr.	Early 1951	Houdry	.....	Cat. Constr. (Philadelphia)
Shell Oil Co.	Provident City, Texas	Gas Stripping	60,000 mcf	$2.5 million	Completed	.....	.....	Fluor	Fluor
Standard Oil Co. of Texas	7 mi. N. Snyder, Scurry Co., Tex.	Gaso. Absorp. Plt.	20,000 mcf	$1.5 million	Under Constr.	Aug., 1950	.....	Staff	Staff
Stanolind O&G	Brownsville, Tex.	Chemical Plant	130 tons	.....	Under Constr.	July, 1950	.....	Badger	Badger
*Superior Oil Co.	Altair Field, Colo. Co., Tex.	Gaso. Plt.	50,000—70,000 mcf. gas	$1.5 million	Planning	.....	.....	.....	.....
The Texas Co.	Tijerina-Canales Field, Texas	Gas Compression	3,000 mcf	.....	Completed	.....	.....	.....	.....
United Gas Pipe Line Co.	Karnes City, Texas	Nat. Gas., Condensate Process	10,000 mcf	$1 million	Completed	.....	.....	Delta	Delta
United Gas Pipe Line	Scottington, La.	Dehydration	†13,000 mcf	.....	Under Constr.	.....	.....	.....	Staff

CONTINUED ON PAGE 71

What technical service can Anaconda give you on Heat Exchangers?

ANACONDA Arsenical Admiralty Tubes being installed in tube bundle at Lemont, Illinois plant of Globe Oil & Refining Co. Fortified against dezincification by the arsenic content, tubes of this ANACONDA Alloy are being used with good results in many types of petroleum refining and other process equipment.

EVERY LARGE USER and manufacturer of heat exchangers builds up wide experience with tube and tube sheet materials. But The American Brass Company serves many such users and manufacturers, shares with each their toughest problems, makes this wider experience available to all.

Special laboratory facilities are maintained for this work. Detailed records of problems, conditions, findings are accumulated. These data, plus the results of continuous laboratory and field tests, are used to solve new problems.

These facilities can help produce the answers to your questions—suggest materials that will give your heat exchangers more dependability, longer life, more value under specific conditions.

We hope you will work with us—let us work with you. Write for Publication B-2, "ANACONDA Tubes and Plates for Condensers and Heat Exchangers." Please address The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

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For efficient heat transfer ANACONDA® HEAT EXCHANGER TUBES

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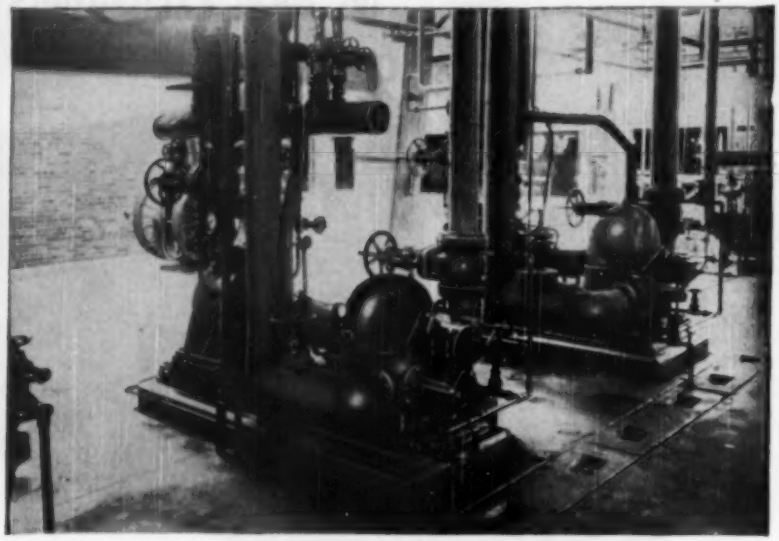


THE ROTORS OF THESE 75 H. P. TERRY TURBINES ARE DOUBLE RIM PROTECTED

The two 75 H.P. Terry Turbines shown above (in the plant of a leading refiner) employ the Terry Solid Wheel Rotor. The wheel is made from a single steel forging and the buckets are milled directly into the wheel. — All as shown in the illustration at the left.

The buckets are protected by rims at the sides of the wheel. These rims would take without damage any rubbing that might occur if the clearance became reduced.

With this construction it is impossible for the blades to foul and frequent inspections of the thrust bearing are not required to obtain safe and dependable operation.

This feature and many others of the Terry Wheel Turbine are fully discussed in our Bulletin S-116.

T-1169

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
ROCKY MOUNTAIN									
Frontier Refining Co.	Cheyenne, Wyo.	2 Coke Crks.	3,300 bbls	$725,000	Under Constr.	Aug., 1950	U.O.P.	Ref. Eng.	Ref. Eng.
Pan-Am Southern	El Dorado, Ark.	Cat. Crk., Vap. Recov.	9,000 bbls.	.....	Contracted	April, 1951	.....	.....	Foster Wheeler
Pan-Am.	El Dorado, Ark.	Coking unit	.....	.....	Under Constr.	Sept., 1950	.....	Lummus	Foster Wheeler
Salt Lake Refining Co.	Salt Lake City	Cat. Cracking	25,000 bbls.	$10 million	Authorized	Jan., 1951	Houdry	Bechtel-Houdry	Bechtel
Sioux Oil Co.	Newcastle, Wyo.	Thermal Crk.	1,200 bbls.	$300,000	Under Constr.	July, 1950	U.O.P.	Koch	Staff
Sioux Oil Co.	Newcastle, Wyo	Cat. Poly.	60 bbls.	$100,000	Under Constr.	July, 1950	U.O.P.	Koch	Staff
WEST COAST									
Continental Oil Co.	Ventura, Calif.	Rev. to Gaso. Plt.	20,000 mcf	.....	Under Constr.	June, 1950	.....	Ref. Maint.	E. & A. Ref. Maint.
*General Petroleum	Torrance, Calif.	Compr. & Heater	.....	.....	Under Constr.	.....	.....	Ref. Maint.	Ref. Maint
General Petroleum	Torrance, Calif.	Add Odor Abate. System	.....	$80,000	Under Constr.	June, 1950	.....	Staff	Staff
General Petroleum	Torrance, Calif.	Dust Collecting Sys. to Gaso. Cat. Crk.	.....	$23,000	Under Constr.	June, 1950	.....	Staff, Ref. Maint.	Ref. Maint.
General Petroleum	Torrance, Calif.	Smoke, Fume, Odor Contrlls.	.....	$250,000	Under Constr.	.....	.....	Staff	.....
General Petroleum	Torrance, Calif.	Cat. Crk., Fur.	4,000 bbls.	.....	Authorized	.....	.....	.....	Lummus
Hancock Oil Co.	Long Beach	Ethylene Glycol	60,000 lbs.	.....	Considering	.....	.....	Badger	Badger
Paloma Refining Co.	Paloma Field, Calif.	Ext. Absp. Sect.	60,000 mcf	.....	Under Constr.	June, 1950	.....	.....	.....
Richfield Oil Corp.	So. Cuyama, Calif.	Absp. & Comp. Plt.	50,000 mcf	.....	Under Constr.	June, 1950	.....	Fluor	Fluor
Stanecal Asphalt & Bitumuls Co.	Point Wells, Wash.	Asphalt Refinery	.....	.....	Under Constr.	Mid., 1950	.....	.....	.....
Standard Oil (Calif.)	Richmond, Calif.	Vac. Tower TCC to Houdry	55,000 bbls. 45,000 bbls.	.....	Approved Engineering	May, 1951 May, 1951	Houdry	Staff	Bechtel
Union Oil Co. of Calif.	Brea Olinda, Cal.	Research Plant	.....	$5 million	Projected	Sept., 1950	.....	.....	.....
Union Oil of Calif.	Oleum, Calif.	Revise Refg.	.....	$4 million	Under Constr.	Spring, 1950	.....	Parsons, E. & A	Ref. Maint.
Union Oil of Calif.	Oleum, Calif.	Improve Handling Facilities	.....	$1.5 million	Under Constr.	Spring, 1950	.....	Mathews, Montgomery	Early, C. N. Peterson, Mathews
Union Oil of Calif.	Oleum, Calif.	Tankage and Utilities	.....	$1.8 million	Under Constr.	Spring, 1950	.....	Parsons	Eaton & Smith, C.B.&I., Utah
Union Oil of Calif.	Oleum, Calif.	Add Main Office Shops	.....	$1 million	Under Constr.	Spring, 1950	.....	Austin, Field & Fry, D. R. Warren Co., Montgomery	E. S. McKittrick, Parker, Steffens & Pearce
Union Oil of Calif.	Oleum, Calif.	Add Ref. Facltz.	.....	.....	Under Constr.	Spring, 1950	.....	.....	.....
FOREIGN									
Canada									
British-American Oil Co.	Edmonton, Alberta	Refinery	6,000 bbls.	.....	Engineering	Early, 1951	.....	Can. Kellogg	Can. Kellogg
British-American Oil	Clarkson, Ontario, Can.	Propane Deasphalt.	700 bbls.	$400,000	Under Constr.	Mid., 1950	S.O.D., Union Oil (Calif.), Standard (Ind.)	Canadian Kellogg	Canadian Kellogg
Excelsior Refs., Ltd.	Lloydminster, Alberta	Cap. Increase	3,000 bbls.	.....	Under Constr.	1950	.....	.....	.....
Excelsior Refs., Ltd.	Lloydminster	Capacity Inc.	1,500 bbls.	.....	Design	1950	.....	.....	.....
Imperial Oil, Ltd.	Leduc Field	Gas Absorption	24,000 mcf	$6.5 million	Under Constr.	Mid. 1950	.....	Braun	Braun
Imperial Oil	Winnipeg	New Refinery	10,000 bbls.	$10 million	Engineering	May, 1951	.....	Canadian Kellogg	Canadian Kellogg
McColl Frontenac Oil Co., Ltd.	Edmonton, Alta.	Crd. Processing Cat. Crk.	5,800 bbls.	$10 million	Contracted	1951	.....	Foster Wheeler	Foster Wheeler
Panther Oil and Grease Co.	Leaside, Toronto, Ontario	Grease and Compounding	.....	.....	Projected	.....	.....	.....	.....
Shell Oil Co. of Canada, Ltd.	Montreal East, Quebec	Fluid Cat. Crk., Vac. Flash Gas Recov., Poly, Treat	35,000 bbls.	.....	Under Constr.	Oct., 1950	.....	Staff	Fluor, Ltd., McKee
Supreme Refineries, Ltd.	Hanna, Alt.	Nat. Gaso. Plt.	1,000 mcf.	$100,000	Under Constr.	June, 1950	.....	Staff	Staff
Supreme Refineries	Ogden, Alt.	Refinery	1,000 bbls.	$100,000	Under Constr.	June, 1950	.....	Staff	Staff
Latin America									
Administracion Nacional Combustible Alcohol y Portland	Montevideo, Uruguay	Lube, Asphalt Units	7,500 bbls.	.....	Under Constr.	June, 1950	.....	Foster Wheeler	Foster Wheeler Staff
Conselho Nacional do Petroleo	Mataripe, Bahia, Brazil	Thermal Cracking Refinery	2,500 bbls.	$5 million	Under Constr.	Dec., 1950	.....	Kellogg	Kellogg, Staff
Conselho Nacional do Petroleo	Cubatao Sao Paulo, Brazil	Therm. Crk. Ref.	45,000 bbls.	.....	Designing	.....	.....	Hydrocarbon	Fives-Lille & Schneider, Staff
Conselho Nacional do Petroleo	Mataripe, Bahia, Brazil	Ref. Expn.	2,500 bbls.	$3.5 million	Planning	Dec., 1950	.....	.....	.....
Creole Pet. Corp.	El Roble Field, Venezuela	Repressuring	.....	.....	Planning	.....	.....	.....	.....
Ipiranga S.A. Cia Brasileira de Petroleos	Rio Grande, Brazil	Therm. Crk. Ref.	2,000 bbls.	.....	Authorized	1952	Foster Wheeler	.....	.....
Mene Grande Oil Co.	Puerto la Cruz, Venezuela	Refinery	30,000 bbls.	.....	.....	.....	.....	.....	.....
Petroleos Mexicanos	Poza Rica, Mex.	Gas Purification Pressure Maint.	.....	$13 million	Under Constr.	Dec., 1950	.....	McKee	McKee
Petroleos Mexicanos	Salamanca, Mex.	Crd., Gasoil, Crk.	28,000 bbls.	$12 million	Under Constr.	Aug., 1950	U.O.P.	McKee	McKee
Petroleos Mexicanos	Reynosa, Mex.	Refinery	4,000 bbls	$1 million	Under Constr.	Jan., 1951	.....	Staff	Staff
Phillips Oil Co.	San Roque Fld., Anzoategui, Ven.	Refinery, Wax Plt.	2 mln lbs. wax/year	.....	Planning	1952	.....	.....	.....
Puerto Rican Oil Refining Co.	Near Ponce, Puerto Rico	Refinery	35,000 bbls.	$20 million	Projected	1st Qtr., 1951	Undetermined	Parsons, Brinckerhoff, Hall and Macdonald	.....
Refinaria de Petroleos do Distrito Federal S.A.	Rio de Janeiro, D. F. Brazil	Therm. Crk.	10,000 bbls.	.....	Authorized	.....	.....	.....	Fives, Lille, Schneider, Staff Foster Wheeler
Refinaria e Exploracao de Petroleo Uniao S.A.	Capuava, Sao Paulo, Brazil	Therm. Crk. Ref.	20,000 bbls.	.....	Authorized	.....	.....	P. A. Hydro. Res.	Czech, Fast. Metal Work Mech. Constr.
Richmond Exploration Co.	Bajo Grande, Venezuela	New Refinery	35,000 bbls.	.....	Deferred	.....	.....	.....	.....
Shell Caribbean Pet. Co.	La Paz, Venezuela	Gas Plant	90 tons	.....	Under Constr.	Spring, 1950	.....	.....	.....

REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Shell Caribbean Pet.	Maracaibo, Ven.	Gas Plant	90 tons	.....	Projected	Early 1951	.....	.....	.....
Venezuelan Pet. Co.	Puerto la Cruz, Venezuela	Refinery	35,000 bbls.	.....	Under Constr.	.....	.....	Snare	Snare
Yacimientos Petrolíferos Fiscales	Buenos Aires, Argentina	New Refinery	28,000 bbls.	$54 million	Design	1951	.....	Kellogg	Kellogg
YPF	La Plata, Argentina	Crude Topping, Gas Treating	80,000 bbls.	$2.5 million	Under Constr.	Spring, 1950	.....	Houdry Process Cat. Constr.	Cat. Constr.
YPF Bolivianos	Cochabamba, Bolivia	Topping & Reforming Units	5,000 bbls.	.....	.....	3rd Qtr., 1950	.....	Foster Wheeler	Foster Wheeler
Europe and Africa									
Anglo-American Oil	Fawley, Eng.	Refinery	110,000 bbls.	$180 million	Under Constr	Late 1951	.....	Foster Wheeler Badger	Foster Wheeler Badger
Anglo-American	Fawley, Eng.	SO2 Extraction	15,000 bbls.	.....	Design	.....	.....	.....	.....
*Anglo-American	Fawley, Eng.	Fluid Cat. Crk.	1 million gals.	.....	Under Constr.	.....	.....	.....	.....
Anglo-Iranian Oil	Isle of Grain, Eng.	Cent. Refg. Unit	60,000 bbls.	$120 million	Planning	1952	.....	.....	.....
Anglo-Transvaal Consolidated Investment Co.	Vall River, Union of South Africa	Synthetic Gasoline and Diesel Oil Plant	.....	$50-60 million	Contracted	.....	.....	Hydro. Res.	.....
Aquila, S.A.	Trieste, Italy	Lube Oil Ref.	800 bbls.	$7.9 million	Design	Mar., 1951	Jutk, Texaco	Badger	Badger
Azienda Generale Italiana Petroli	Rome, Italy	Add to Plant	24,000 bbls.	.....	Projected	Late 1951	.....	.....	.....
Azienda Generale Italiana Petroli	Palermo, Italy	Marine Fuel Plant	7,800 bbls.	.....	.....	.....	.....	.....	.....
My. Batavsche Pet.	Pernis, Holland	Expansion	80,000 bbls.	.....	Under Constr.	Mid 1952	.....	.....	.....
British Petroleum Chem.	Grangemouth, Scotland	Petrochem	.....	.....	Under Constr.	Dec., 1950	.....	Stone & Webster	Stone & Webster
Cabot Carbon, Ltd. (Godfrey L. Cabot, Inc.)	Ellesmere Port, Eng.	Carbon Black Plant	80,000 lbs./yr.	.....	Under Constr.	1950	.....	Simon-Carves, Ltd.	Simon-Carves, Ltd.
Cie. de Raffinage Shell-Berre	Berre, France	Expansion	30,000 bbls.	$31.6 million	Under Constr.	Mid., 1951	.....	.....	.....
Shell	Petit-Couronne	Teepol Plant	33,000 tons/yr.	.....	Under Constr.	1st Qtr., 1951	.....	.....	.....
Cie. de Raffinage Shell-Berre	Petit-Couronne, France	Lube Unit	.....	.....	Planned	.....	.....	.....	.....
Cie. de Raffinage Shell-Berre	Petit-Couronne (Rouen), France	Expansion	10,000 bbls.	.....	Under Constr.	July, 1950	.....	.....	.....
Cie. Francaise de Raffinage	Gonfreville, France	Therm. Reform., Prop. Deasp., Furf. Trtng.	4,750 bbls	.....	Design	1951	Texaco & Jutk	Kellogg	Local
Cie. Francaise de Raffinage	Gonfreville, France	Lube Unit	2,500 bbls.	.....	Design	1951	Texaco	Kellogg-Lummus	.....
Cie. Francaise de Raffinage	Gonfreville, France	Distillation Unit	20,000 bbls.	.....	Under Constr.	3rd Qtr., 1950	.....	Foster Wheeler	Foster Wheeler
Cie Francaise de Raffinage	Provence, France	Topping Unit	20,000 bbls.	.....	Under Constr.	4th Qtr., 1950	.....	Foster Wheeler	Foster Wheeler
Cia Espanola de Petroleos, S.A.	Sta. Cruz de Tenerife, Canary Islands	Propane-Butane Fractionating,	304 bbls.	$100,000	Under Constr.	Late 1950	Standard Oil Texaco	U.O.P. Foster Wheeler	U.O.P. Foster Wheeler
C.E.P.S.A.	Canary Islands	Propane-Deas.	700 bbls	$300,000	Under Constr.	Late 1950	Standard Oil Texaco	Foster Wheeler	Foster Wheeler
C.E.P.S.A.	Canary Islands	Furf. Ref. Sol.	425 bbls.	$4.5 million	Completed	.....	.....	Foster Wheeler	Foster Wheeler
		MEK Dewax.							
Condor, S.P.A. Per l'Industriale Pet. Chemica	Rho, Italy	New Refinery	1.5 mln tons/yr.	.....	Under Constr.	.....	.....	.....	.....
Danish Government	Denmark	Refinery	21,000 bbls.	.....	Planned	.....	.....	.....	.....
Egyptian Government	Cairo, Egypt	Crude Plant	.....	.....	.....	.....	.....	Lummus	Lummus
Industria Chimiche Italiane Petroli	Mantua, Italy	Crude	4,500 bbls.	.....	.....	.....	.....	.....	.....
Industria Nazionale Petroli e Trasformazione	Massa Carrara, Italy	Refinery	40,000 bbls.	.....	.....	Late 1951	.....	.....	.....
Industria Petrolifera e Chimica	Milan, Italy	Gasoline Fuel Oil Plant	30,000 bbls.	.....	.....	.....	.....	Dr. Calogero Inglogio	.....
Imperial Chemical Industries, Ltd.	Wilton, Yorkshire, England	Petroleum Cracking Unit	.....	.....	Under Constr.	End 1950	.....	Kellogg	Kellogg
L'Alliance Petrolina	Antwerp, Belg.	Refinery	21,000 bbls.	.....	Planned	.....	.....	.....	.....
Manchester Oil Refinery, Ltd.	Partington, England	Cat. Crk., Lube Reforming	20,000 bbls.	.....	Projected	.....	.....	.....	.....
Monsanto Chemical Co.	Britton	Add Polystyrene	.....	.....	Under Constr.	July, 1951	.....	Staff	Staff
National Oil Refineries	Llandarcy, Wales	Furf. Ref. Sol. Dewax, Wax Fractn.	1,300 bbls.	$36 million	Designing	Early 1953	Texaco	Badger	Badger
National Oil Refineries	Llandarcy, Wales	SO2 Solvent Extraction	3,000 bbls.	.....	Contracted	Early 1951	.....	H.W.P.	H.W.P.
Pechelbronn, S. A. E. M.	Merkwiller, France	Capacity Increase	1,350 bbls.	.....	Authorized	1950	.....	.....	.....
Petrocarbon, Ltd.	Partington, England	Cat. Cracker, Lube & Reform	20,000 bbls.	.....	.....	.....	.....	.....	.....
Petro Chem., Ltd.	Partington, England	Petrochemicals	2,000 bbls.	$16 million	Under Constr.	2nd Qtr., 1950	Petro-Carbon	Petro-Carbon	Petro-Carbon
Philblack, Ltd.	Avonmouth, England	Carbon Blk. Plt.	137,000 bbls.	$5 million	Contracted	Aug., 1950	Phillips	H.W.P.	H.W.P.
Ref. de Pet. de Escom. S.A.	Escombreras, Spain	Add Refinery	20,000 bbls.	.....	Under Constr.	Oct. 1, 1951	.....	.....	.....
Ref. Belgo	Antwerp, Bel.	Atmos., Vac. Distill.	7,000 bbls.	$1.5 million	Planning	June, 1951	.....	.....	.....
Raffinerie Belge de Petroles S.A.	Antwerp, Belgium	Therm. Crk., Reform., Gas Plant	7,000 bbls.	$7 million	Under Constr.	July, 1950	.....	Barnes	Barnes
Raffinerie Francaise de Petrole de l'Atlantique	St. Nazaire, France	Comodedato Refinerie	7,100 bbls.	$9.4 million	.....	.....	.....	.....	.....
Raffinerie Siciliane Oli Minerali, Sp.A.	Augusta, Sicily	Crude Refinery	10,000 bbls.	.....	Under Constr.	July, 1950	U.O.P.	U.O.P., Delta, Staff	Staff
Scottish Oils, Ltd.	Grangemouth, Scotland	Stage I: 1 Pipe Still Distill., Steam Boil. & Power Plt.	1.5 mln. tons per yr. 20,000 kw.	.....	Under Constr.	End 1950	.....	Kellogg	Kellogg
Scottish Oils	Grangemouth, Scotland	Stage II. Cat. Crk., Vac. Distill., Cat. Poly Plt., & Trtng Plt.	.....	.....	Planned	Mid., 1952	.....	.....	.....
Scottish Oils, Ltd.	Grangemouth, Scot.	Buoyancy Foundations	.....	.....	Under Constr.	End 1950	.....	Rendel Palmer and Tritton	.....
Shell Chemical Mfg. Co., Ltd.	Thornton, Eng.	Teepol Plant Extension	75,000 tons per year	.....	Under Constr.	Spring, 1950	.....	.....	.....
Shell Refining & Marketing Co., Ltd.	Stanlow, Eng.	Comprehensive Refining	90,000 bbls.	.....	Under Constr.	Early 1952	.....	.....	.....

CONCLUDED ON PAGE 75

COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company "Bridgeport" *Headquarters for BRASS, BRONZE, and COPPER*

Effect of Water Velocity on Condenser Tube Life

Does the water velocity affect the corrosion rate of condenser and heat exchange tubing? Experience has shown that water velocity is a very important factor, but there are many other contributing elements which must be taken into account, such as the temperature, fouling organisms and the character of the water—degree of salinity, pH value, amount of gases such as oxygen, hydrogen sulfide, carbon dioxide and others; concentration of foreign matter such as sand, cinders, shells, oil. The corrosion resistance of the condenser tube alloy itself also plays a very important part.

Effect of High Water Velocities

Increased water velocities and turbulence may result in impingement corrosion failure which is brought about by the impact of the water on the metal surface. This type of attack is generally recognized by the presence of almond or crescent shaped pits, undercut at one end, and usually free from corrosion products in the pits themselves.

Continued impingement of the stream against the tube in one spot leads to the removal of normal corrosion film until the base metal is exposed which then corrodes at a much higher rate than normal.

Impingement Corrosion Destructive

Impingement corrosion is most commonly found at the point of impact which is generally near the inlet end of the tubes where turbulence is present due to the restriction and speed-up of the water stream as it enters the tubes from the water box. Pieces of shells, stones, coke and other foreign matter lodged in condenser tubes may cause the water to be deflected against the opposite side of the tube, resulting in impingement corrosion at that point.

The presence of sand and entrained gases leads to increased attack. Water carrying sand or silt, in the absence of direct impingement may produce a scouring or abrasive action which may in time seriously reduce the wall thickness of the tubes.

Entrained bubbles of gas greatly increase the rate of impingement. This

Figure 1. Illustrating impingement corrosion at inlet end of Admiralty condenser tube. Tube has been split lengthwise and flattened.

is aggravated in sea water by the presence of hydrogen sulfide resulting from bacterial action on organic material. Impingement corrosion can be reduced by removing entrained gases from corrosive water by various devices used for this purpose.

Obviously, whatever can be done to remove these disturbing influences will lengthen tube life. It is desirable to keep intake tunnels clean and use fine screens to prevent shells and debris from entering the tubes.

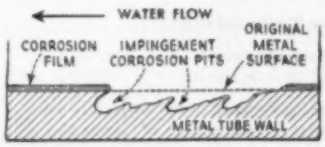


Figure 2. Section through wall of tube shows how impingement of stream removes corrosion film and corrodes base metal to form crescent-shaped pits.

Effect of Too Low Water Velocities

Water velocity which is too low, may be troublesome because it permits the attachment of slime, marine growth, barnacles, mussels and other foreign matter to attach themselves to the tube wall. Once this condition is established, higher velocities cannot readily remove them. However, high water velocities usually prevent larger marine organisms from obtaining a foothold.

Slime is undesirable because it cuts down heat transfer, bringing about a drop in vacuum which may waste fuel.

Low water velocities encourage the settling of sand, clay and other foreign materials on the tube surface and contribute to damage from pitting. It may be necessary to use settling basins, screens or strainers in order to eliminate debris from the water before it reaches the condenser. Speeding up the water may prevent settling in the tubes but opens up the possibility of encouraging impingement corrosion at the inlet ends of the tubes.

Steps used to keep tubing free from slime and other foreign attachments include periodical chlorination, cleaning with rubber plugs, brushes, high pressure water jets or other methods.

Influence of Condenser Tube Alloys

Experiments over a long period of time indicate that alloys vary considerably in their resistance to impingement corrosion. Aluminum brass is superior to Admiralty tubing in resisting this type of attack. Cupro Nickel has proven to be excellent in resistance to corrosion from sea water flowing at high velocities. Duronze IV, Arsenical aluminum bronze is giving a fine account of itself in resisting this type of attack.

Bridgeport maintains an active corrosion research laboratory for studying the behavior of copper-base alloys in corrosive environment. Call on our nearest district office for further information on condenser and heat exchange tubing.

BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN. • *ESTABLISHED 1865*

Mills at Bridgeport, Connecticut, and Indianapolis, Indiana • In Canada: Noranda Copper and Brass Limited, Montreal

NEW

Latest Developments in HOT-PROCESS SOFTENERS

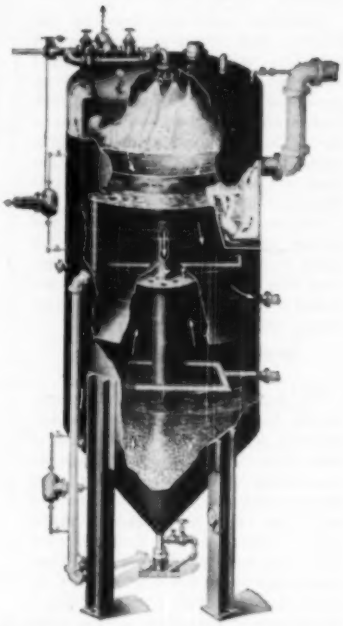
Described in this 36-page bulletin

Here is a bulletin that should be read by every plant executive and engineer with boiler feed problems.

It is *authoritative* because it is prepared by the engineers and chemists of an organization with more than *40 years of experience* in the field of hot process treatment and general boiler feedwater treatment.

It is *informative* because it clearly shows the practical applications of the scientific principles involved in modern, efficient hot process softener designs.

Copies of the bulletin will be sent without charge to plant executives and engineers writing on their Company letterhead.



SOME OF THE SUBJECTS COVERED

Operating problems requiring boiler feedwater treatment

The 12 principal methods of feedwater treatment

Why the hot-process treatment is widely used

Chemistry of the hot-process treatment

Basic principles and requirements of modern hot-process softener design

How a GRAVER Hot-Process Softener operates

16 Designs of modern hot-process softeners and where each should be used

Hot Zeolite Softening

Latest developments in chemical feeders and their accessories

Results obtained from hot-process softeners in various types of installations

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REFINERY AND OTHER PLANT CONSTRUCTION—*Continued*

COMPANY	Plant Site	Project	Daily Capacity	Estimated Cost	Status	Probable Completion	Licensor	Engineering	Contractor
Shell Refining & Marketing Co., Ltd.	Shell Haven, England	Comprehensive Refining	40,000 bbls.	$34 million	Under Constr.	Mid 1952	.....	.....	.....
Societe Generale des Huiles de Petrole	Lavera, France	LPG Units	25,000 bbls.	.....	Under Constr.	Mid 1950	Kellogg	Kellogg	Staff
Societe Generale.....	Dunkirk, France	Crude Refinn.	33,000 bbls.	.....	Under Constr.	Mid 1951	Lummus, Kellogg	Lummus, Kellogg	Lummus, Kellogg
Societe Generale.....	Dunkirk, France	Fuel, Ref. Sol. Dewax., Wax Fracts.	2,400 bbls	.....	Under Constr.	Mid 1951	Texaco	Lummus	Lummus
Societe Industrial Belge des Petroles	Antwerp, Belgium	Cnd. Crk. Ref.	30,000 bbls.	.....	Under Constr.	Mid 1951	.....	Kellogg	Kellogg
Societe Raffinazione Oli Minerali (IROM)	Porto Marghera, Italy	Atmospheric & Vac. Distill., Acid Treat., Contact Filtrators for Lube Oils, Electric Gen. Unit, Lond. Facilities	11,600 bbls.	$6.4 million	Contracted	.....	.....	H.W.P.	H.W.P.
Societe per Azioni Raffineria Padana Oli Minerali	San Martino di Trecate, Italy	Refinery	13,000 bbls.	.....	Proposed	.....	.....	.....	.....
Socony-Vacuum Francaise	Notre Dame de Gravenchon	MEK Unit	1,000 bbls.	.....	Under Constr.	Fall, 1950	Texaco	Lummus	Staff
Socony-Vacuum Francaise	Notre Dame de Gravenchon	Propane Deasphalting	1,100 bbls.	.....	Under Constr.	Summer, 1950	Juik	Lummus	Staff
Socony-Vacuum Francaise	Notre Dame de Gravenchon	Grease and Compounding	900 lbs.	.....	Under Constr.	Winter, 1950	.....	Staff	Staff
Socony-Vacuum Italiana, S.p.A.	Naples, Italy	Visbreaker	.....	.....	.....	Fall, 1950	.....	Staff	Staff
Socony-Vacuum Italiana, S.p.A.	Naples, Italy	Topping Unit	15,000 bbls.	.....	Under Constr.	Fall, 1950	.....	Staff	Staff
Stand.-Anienda Gen. Indro. Comb. (Stanic)	Leghorn, It.	Add Capacity	28,700 bbls.	.....	.....	.....	.....	.....	.....
Ditto (Stanic).....	Bari, Italy	Add Capacity	38,800 bbls.	.....	.....	.....	.....	.....	.....
Standard Francaises des Petroles	Port Jerome, France	Dewaxing Plant	1,200 bbls.	$6.4 million	Design	Late 1951	.....	S.O.D.	Foster Wheeler
Standard Francaises des Petroles	Port Jerome, France	Deasphalting Plant	1,500 bbls.	.....	Design	Late 1951	.....	S.O.D	.....
Standard Oil Co., (N.J.)	Belgium	Dist. Crack.	33,000 bbls.	.....	Planned	Early 1952	.....	.....	.....
Trent Oil Prod. Development Co.	North Shields, England	Crude Plant	11,500 bbls.	$4.8 million	Plans approved	.....	.....	.....	.....
Union Petrol Refinery, Ltd.	Johannesburg, Union of South Africa	New Refinery	.....	$28 million	Projected	.....	.....	.....	.....
Vacuum Oil Co., Ltd.	Coryton, Eng	Lube Refinery	20,000 bbls.	$30 million	Planned	Sept., 1952	.....	.....	.....
Near East									
Anglo-Iranian Oil.....	Abadan, Iran	Gas Plant	25,000 mcf	$2 million	Under Constr.	1950	.....	Badger	Badger
Anglo-Iranian.....	Abadan, Iran	Cat. Cracker	20,000 bbls.	.....	Under Constr.	1951	.....	Foster Wheeler	Foster Wheeler
Anglo-Iranian.....	Abadan, Iran	Solvent Dewax.	700 bbls.	.....	Under Constr.	4th Qtr., 1950	Texaco	Badger	Badger
Anglo-Iranian.....	Abadan, Iran	Gas Recov., Stab.	22,000 mcf	.....	Under Constr.	Mar., 1951	.....	Badger	Badger
Arabian American Oil Co.	Abqaiq, Saudi Arabia	Crude Oil Stabilizer	300,000 bbls.	$4.8 million	Under Constr.	Dec., 1950	.....	Staff and Fluor	Fluor
Arabian American ...	Ras Tanura, S.A.	Asphalt Plant	500 bbls.	$1.25 million	Under Constr.	1950	.....	Staff, Bechtel	Staff
Bahrein Pet. Co., Ltd.	Bahrein Island	Crd. Spill Util.	55,000 bbls.	$9.1 million	Under Constr.	Aug., 1950	.....	Lummus, Bechtel	Int. Bechtel, Inc.
Consolidated Ref., Ltd.	Haifa, Palestine	Crude Plant	80,000 bbls.	.....	Planned	Late, 1951	.....	Badger	Badger
Consolidated Ref., Ltd.	Haifa, Palestine	Cen. Facilities	.....	.....	Under Design	.....	.....	Badger	.....
Consolidated Ref., Ltd.	Haifa, Palestine	Lube Plant	2,300 bbls.	.....	Designing	.....	Texaco, Juik	Lummus, Kellogg	Lummus, Kellogg
Far East									
Bataafsche Pet. Mij. (Shell)	Balikpapan, Borneo, East Indies	Expansion	42,000 bbls.	.....	Under Constr.	Mid 1952	.....	.....	.....
Bataafsche Pet. Mij.	Pladjoe, Sumatra	Rehab. to Comprehensive Refg.	70,000 bbls.	.....	Under Constr.	Mid 1951	.....	.....	.....
Burmah Oil Co., Ltd.	Syriam, Burma	Furf., Sol. Dewax., Wax Mfg.	1,000 bbls.	$600,000	Designing	.....	Texaco	Badger	.....
Burmah Oil Co.....	Syriam, Burma	Thermafor Clay Revivification	66 tons	$150,000	Engineered	1950	Max Miller, Socony-Vacuum	Max Miller	.....
Pacific Refineries, Ltd.	Honolulu, Hawaii	Butane, Asph., Gas Oil, Lt. Fretns. Refy.	3,000 bbls.	$1.5 million	Under Constr.	Late Summer, 1950	.....	Fish Eng	Fish Eng
*Ton Nenryo Kogyo, Ltd.	Wakayama, Japan	Cracking	3,500 bbls.	.....	Designing	Fall, 1950	.....	.....	Staff
Oceania									
Australian Shell Oil Co.	Clyde, New S. W., Australia	Luboil Refining	250 bbls.	.....	Under Constr.	Late 1950	.....	.....	.....
Australian Shell Oil Co.	Geelong, Victoria, Australia	New Refinery	.....	$4.8 million	Under Constr.	Late 1951	.....	.....	.....
Australian Shell Oil Co.	Geelong, Victoria, Australia	Bitumen and Luboil Plant	.....	.....	Projected	.....	.....	.....	.....
Australian Shell Oil Co.	Geelong, Victoria, Australia	Asphalt, Lube Sol. Extct Plt.	.....	.....	.....	.....	.....	.....	.....

* First appearance in tabulation. † Added capacity.

NOTE: Austin—Austin Co. Badger—E. B. Badger & Sons. Barnes—W. M. Barnes & Co. Bechtel—Bechtel Corp. Bellows—W. S. Bellows Co. Blaw-Knox—Blaw-Knox Construction Co. Bowden—W. H. Bowden. Braun—C. F. Braun Co. Brown Eng.—Brown Engineering Co. Brown & Lite—Brown & Lite Co. Brown & Root—Brown & Root Construction Co. Can. Kellogg—Canadian Kellogg Co. Cat. Constr.—Catalytic Construction Co. Chemico—Chemical Construction Co. C.B.&I.—Chicago Bridge & Iron Works Co. Clarke—Clarke Construction Co. Constr. Service—Construction Service Co. Delta—Delta Engineering Corp. Dresser—Dresser Engineering Corp. E.&A.—Ehrhart & Arthur, Inc Ferguson—H. K. Ferguson. Fish Eng.—Fish Engineering Corp. Fluor—Fluor Corp. Foster Wheeler—Foster Wheeler Corp. Gaso. Plant—Gasoline Plant Construction Co. General American—General American Transportation Co. Girdler—The Girdler Corp. Graff—Graff Engineering & Equipment Co. Grebe & Doremus—Grebe & Doremus Process Co. Hammond—Hammond Iron Works Co. Harris—John W. Harris Associate, Inc. Houdry—Houdry Corp. Howard-Mitchell—Howard-Mitchell Construction Co. Hudson—Hudson Engineering Corp. H.W.P.—Head Wrightson Process, Ltd. Hydro Res.—Hydrocarbon Research, Inc. Ind. Eng.—Industrial Engineers, Inc. J.&L. Constr.—Construction Division, Jones & Laughlin Supply Co. Kellogg—M. W. Kellogg Co. Koch—Koch Engineering Co. Koppers—Koppers Co., Inc. Knowles—Morris Knowles & Co. Kuutson—Kuutson Construction Co. Leonard—Leonard Construction Co. Lummus—The Lummus Co. Mahoney—Mahoney Contracting Co. Mason—Mason Brothers Construction Co. Mathews—Mathews Conveyor Co. McKee—Arthur G. McKee Co. Max Miller—Max B. Miller & Co. Michael Poling—Michael-Poling Construction Co., Inc. Montgomery—J. M. Montgomery & Co. P. A. Hydro Res.—Pan American Hydrocarbon Research, Inc. Parsons—The Ralph M. Parsons Co. Pereo—Division Phillips Petroleum Co. Pet. Eng.—Petroleum Engineering, Inc. Petreco—Petroleum Rectifying Co. Pritchard—J. F. Pritchard Co. Pro. Eng.—Prorose Engineers, Inc. Process Constr.—Process Construction Co. Ref. Eng.—Refinery Engineering Co. Ref. Maint.—Refinery Maintenance Co., Inc. Rust Eng.—Rust Engineering Co. Rust Pro.—Rust Process Design Co. Schneider—Schneider & Co. Sneare—Frederick Sneare Corp. Sollitt—Sumner S. Sollitt Co. S.O.D.—Standard Oil Development Co. State Eng.—State Engineering Co. Stearns-Roger—Stearns-Roger Manufacturing Co. Stone & Webster—Stone & Webster Construction Co. Telespans—Telespans Construction Co. Texaco—Texaco Development Co. U.O.P.—Universal Oil Products Co. Utah—Utah Construction Co. Voorhees, Walker, Foley & Smith. Waleo—Waleo Engineering. West—F. S. West Construction Co. White—J. H. White Eng. Corp. Wohlfeld—Wohlfeld Construction Co. Equally owned California Texas Corp. and Socony-Vacuum Oil Co., Inc.

BOOKS of Current Interest

ASA Code Identification For Gas-Mask Canisters

Two new gases have been included in the first revision in 20 years of American Standard safety code for identification of gas-mask canisters (K13.1-1950) issued by the American Standards Association. The individual color or marking to be used on each gas-mask canister indicates the type of gas or vapor for which it provides protection. Colors are given to identify hydrocyanic acid gas and chlorine gas-mask canisters.

Also listed are the colors assigned to canisters for protection against acid gases, organic vapors, ammonia gas, carbon monoxide, dusts, fumes, mists, fogs, and smokes in combination with any of the aforementioned gases or vapors, acid gases and organic vapors, and ammonia gas.

This standard was developed by a committee representing the manufacturers, users, insurance companies, and the government sponsored by the National Safety Council under the procedures of the ASA.

For a copy write American Standards Association, 70 East 45th Street, New York 17. Priced 35 cents each.

Lummus Process Reference

"Petroleum Horizons," covers petroleum refining, petrochemical, and chemical manufacturing activities of The Lummus Company in the U. S. and abroad and gives descriptions of company services and facilities. Approximately 31 flow diagrams are shown for processes of distillation, cracking, coking and polymerization, aviation gasoline manufacture, lube oil processing, light products treating and finishing, and chemicals from petroleum. Accompanying text discusses technical, economic, and other phases of each process. Oil heater and heat exchanger divisions are also described with the balance of the 80-page book containing approximately 75 color photographs showing process units, bar charts, drawings, and a flow diagram depicting processing sequence from crude oil to products in a modern, integrated refinery.

For a copy write The Lummus Company, 385 Madison Avenue, New York 17. Free.

Index of Nomograms

"Index of Nomograms," compiled and edited by Douglas P. Adams, associate professor of graphics, Massachusetts Institute of Technology, lists over 1700 published nomograms in well-known periodicals and thus serves as a timesaver in the repeated solution of mathematical formulas. The index directs one to the nomogram needed for the quick and accurate solution of the problem.

In the key words section, the first of two main parts, an alphabetical list is given of key words which are associated with each of the diagrams. Following each entry is Index B, the master index, where the periodical, date of issue, volume, number, and page number of the nomogram are listed. Also included are the variables employed in each diagram in a bracket following its title so that one will know its content at a glance.

The Technology Press (Massachusetts of Technology) and John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16. Price $4.00.

Petrochemicals Growth

Growth of the American petrochemicals industry, its problems and possibilities is given in "The Petroleum Chemicals Industry," by Richard Frank Goldstein, a fellow of the Royal Institute of Chemistry and the Institute of Petroleum. Special emphasis is on the development of the past 10 years.

Dr. Goldstein's primary objective is to survey the fields of industrial chemistry in which oil is the most economic starting material. Beginning with the source materials of the petroleum chemicals industry, he treats the chemistry of paraffins, the manufacture of olefins and other important classes of hydrocarbons, and the manufacture and reactions of the major petroleum chemicals. The book concludes with a discussion of the chemical by-products of refinery operations and several related appendices.

John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16. Price $8.50.

History of Steel Casting

"A History of Steel Casting," published under the auspices of Division No. 1, Steel Founders' Society of America, includes a general history of the ferrous foundry industry, and reports on the origin of steel castings in Germany, Switzerland, England, and the United States. A detailed primer of steel casting production covers practice, process, molding, pouring, pattern making, cleaning and finishing, testing and inspection, and the variety of steel castings available.

Photographs of individual plants, personalities, and processes; distinguished scratchboard drawings and sketches are included as is a national map showing geographical divisions of Steel Founders' Society.

For a copy write William H. Worrilow, President, Lebanon Steel Foundry, Lebanon, Pa. Price $2.50.

Machinery Foundations

"ESL Bibliography No. 5" is a list of 120 annotated references to selected books and periodical articles published from 1924 to 1949 on the theory, design, and construction of machinery foundations. Also covered are specific problems such as heavy machinery foundations on unstable soils, and the vibration problem related to foundations of hammers, oil engines, electrical machinery, turbines, steam engines, compressors, machine tools, pumps, presses, etc.

Engineering Societies Library, 29 West 39th Street, New York 18. Price $2.00.

Harmony In Grays Planned For Industrial Equipment

American Standards Association announces adoption of four accurately defined grays as standard finishes, following a consensus reached by 18 organizations and groups who represent all classes of manufacturers and users of industrial apparatus, machines, and equipment.

The standard on "Gray Finishes for Industrial Apparatus and Equipment," includes scope, identification, standard grays, secondary standards, tolerances, gloss, and texture. Two appendices give Munsell notations and scale information.

For a copy of the standard write American Standards Association, 70 E. 45th Street, New York 17. Price is 35 cents a copy. Four color chips are available for $2.25, with chips and standard, when bought together, priced at $2.50.

Bureau of Mines Issues Aviation Gasoline Survey

Characteristics of commercial aviation gasolines produced in the United States during October, 1949 were about the same as of those manufactured in January 1949 and in several preceding years, according to a national annual survey of aviation fuels described in a Bureau of Mines report.

The average octane numbers of the four grades of aviation fuel, computed on the basis of lean-mixture and rich-mixture performances, varied little from those of previous surveys, the Bureau report showed.

Reid vapor pressures and distillation temperatures also showed slight variation compared with fuels tested and reported in two previous surveys by the Bureau.

Prepared by O. C. Blade, Bureau petroleum chemist, the report also gives summary tables and charts comparing gasolines in six aviation fuel surveys. The report is one of a series on aviation gasolines made in cooperation with the Coordinating Fuel and Equipment Research Committee of the Coordinating Research Council, Inc.

For a free copy of Report of Investigations 4664, "National Annual Survey of Commercial Aviation Gasoline, October 1949 Production," write Bureau of Mines, Publications Distribution Section, 4800 Forbes Street, Pittsburgh 13.

Natural Gas and Gasoline

Dr. R. L. Huntington, PR author and chairman of the school of chemical engineering at the University of Oklahoma, Norman, has authored "Natural Gas and Natural Gasoline," his first book dealing with the production and transportation of natural gas from the oil well to the city gate. Written to meet the need of engineering students taking courses which deal with the production of natural gas from crude oil, condensate and dry gas fields, and the manufacture of liquefied products from this raw material, the book shows how fundamental principles can be applied to the solution of many practical problems involving the design and operation of gas gathering and natural gasoline recovery systems.

Lawrence S. Reid and Dr. Frank C. Fowler, both professors of chemical engineering, are credited by Dr. Huntington with contributions. Publisher is McGraw Hill Book Company, Inc., New York.

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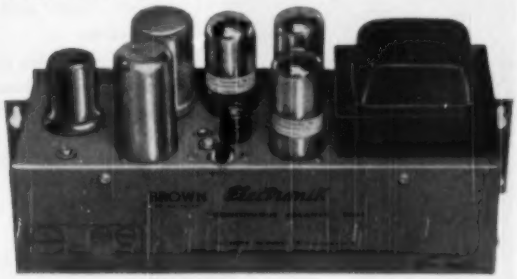

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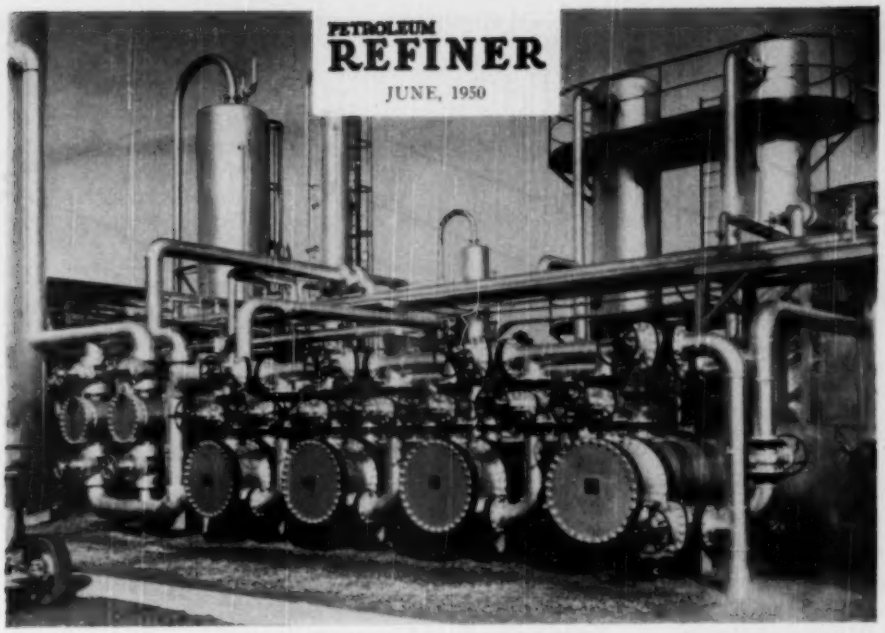


Short Cuts in Process Design—
HEAT EXCHANGERS

PAUL BUTHOD
University of Tulsa, Tulsa

***HEAT EXCHANGERS** are usually made for a specific service and, except for a few standardized cases, the unit is designed and built for a definite set of operating conditions. In spite of this, however, a given exchanger may perform a variety of services in a plant before it is thrown on the junk pile. This is caused by various factors, among which are, increasing the plant capacity, changing the type of crude, modernizing the flow plan and economic considerations which require different products from time to time. The process engineer must use the equipment at hand and purchase a minimum of new equipment for these changes.*

MOST formulas on heat transfer are written in such a way that it is easier to set operating conditions and solve for required surface than it is to start with a given size unit and predict how it will operate. The accompanying formulas are designed to help the process engineer predict how his exchanger will operate under different conditions.

For this discussion, heat exchangers may be placed in three broad classifications based on routing of the two fluids:

1) Counter-current flow in which a log mean temperature difference or a corrected log mean temperature difference applies.

2) Counter-current flow in which arithmetic mean temperature difference should be used.

3) Parallel flow.

The first of these is by far the most common and takes in most commercial exchangers including those in which one fluid does not change in temperature, such as condensing steam or boiling liquids.

The general equation of heat transfer by convection in terms of the original operating conditions is as follows:

$$q = UAF\Delta T_m \qquad (1)$$

This may be written as follows:

$$(t_2 - t_1)mc = UAF\left[\frac{(T_1 - t_2) - (T_2 - t_1)}{\text{Ln}\,\frac{T_1 - t_2}{T_2 - t_1}}\right] \qquad (2)$$

The temperatures used in equation 2 are those indicated in Figure 1A, and F refers to the correction for multipass exchangers. (All symbols are listed in the accompanying notation.)

Rearrangement of equation (2) gives the form which follows on the next page.

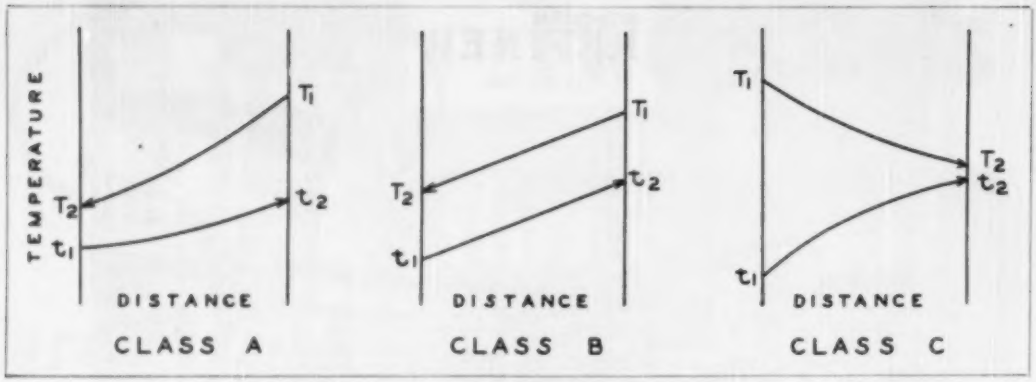


Figure 1. Routing of Streams

$$\frac{mc}{UAF} = \frac{\dfrac{T_1 - T_2}{t_2 - t_1} - 1}{Ln\left[\dfrac{T_1 - t_2}{T_2 - t_1}\right]} \qquad (3)$$

From an over-all heat balance,

$$mc(t_2 - t_1) = MC(T_1 - T_2) \qquad (4)$$

To simplify handling the formulas, make the following substitutions.

$$X = \frac{mc}{MC} = \frac{T_1 - T_2}{t_2 - t_1} \qquad (5)$$

$$Y = \frac{T_1 - t_2}{T_2 - t_1} \qquad (6)$$

$$Z = \frac{mc}{UAF} = \frac{X - 1}{Ln\ Y} \qquad (7)$$

Values of Z may be calculated by equation (7) or may be obtained from Figure 2 when X and Y are known.

Eliminating T_2 between equations (5) and (6) gives the following.

$$t_2 = t_1 + \frac{(T_1 - t_1)}{D} \qquad (8)$$

Where,

$$D = (XY - 1)/(Y - 1) \qquad (9)$$

Values of D may either be calculated from equation (9) or read from

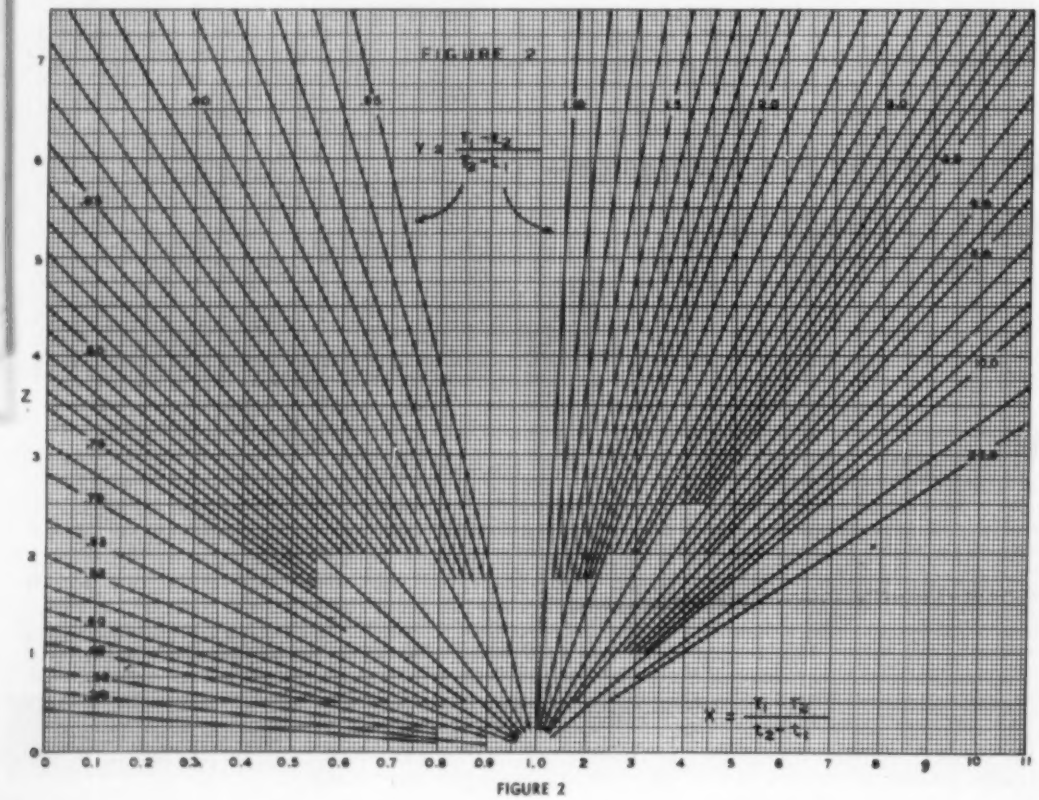


FIGURE 2

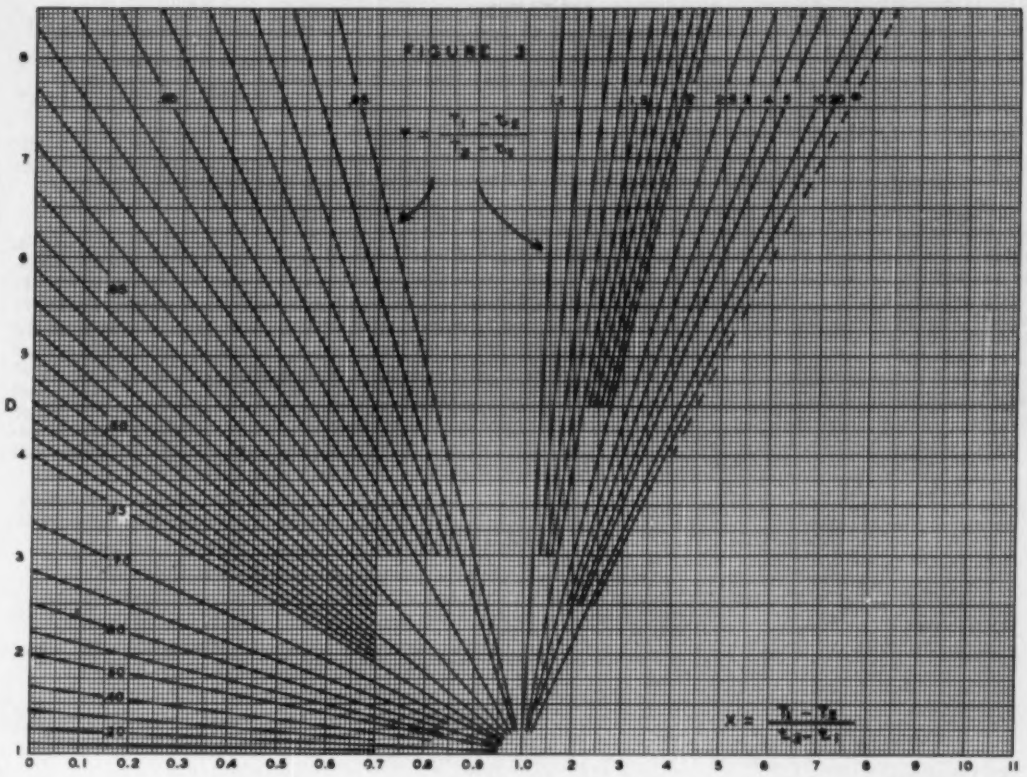


FIGURE 3

Figure 3 when X and Y are known.

T_2 may be obtained by eliminating t_2 from equations (5) and (8). The result is given as follows.

$$T_2 = T_1 - \frac{X}{D}(T_1 - t_1) \qquad (10)$$

Equations (8) and (10) give the outlet temperatures in terms of the inlet temperatures and the two constants, X and D.

When studying the new operating conditions, the same symbols will be used and the same equations developed. When a formula refers to a new set of operating conditions, the symbols will carry a prime (′) to indicate new conditions. The two equations which give outlet temperatures will be given for the new set of conditions.

$$t_2' = t_1' + \frac{T_1' - t_1'}{D'} \qquad (11)$$

$$T_2' = T_1' - \frac{X'}{D'}(T_1' - t_1') \qquad (12)$$

The constants X′, Y′, Z′, and D′ will change with different operating conditions. These constants may be calculated entirely from the new operating conditions or may be obtained from the original constants by means of ratios.

$$X' = \frac{m'c'}{M'C'} = X\,\frac{m'c'M\,C}{m\,c\,M'C'} \qquad (13)$$

$$Y' = e^{(X'-1)/Z'} \qquad (14)$$

$$Z' = \frac{m'c'}{U'A'F'} = Z\,\frac{m'c'U\,A\,F}{m\,c\,U'A'F'} \qquad (15)$$

$$D' = (X'Y' - 1)/(Y' - 1) \qquad (16)$$

The above formulas were derived on the basis of sensible heat intake of the cold fluid. In the case where the cold fluid absorbs only latent heat and therefore remains at constant temperature, the formulas break down. For this case, the same formulas apply if the capital letter symbols are made to refer to the cold fluid and the lower case letters refer to the hot fluid. This will be illustrated later in Example 3.

When the ratio of flows on the hot and cold side is such that the constant X or X′ is close to unity, the log mean temperature difference formula becomes indeterminate and in that region the formulas developed above are hard to use accurately. For that reason, the same type formulas will be developed using an arithmetic mean temperature difference.

Starting with the general formula,

$$(t_2 - t_1)\,mc = UAF\left[\frac{(T_1 - t_2) + (T_2 - t_1)}{2}\right] \qquad (17)$$

and the same definition for Z, Z′, X, and X′ as used before, the following equations result.

$$t_2' = t_1' + \frac{T_1' - t_1'}{D'} \qquad (18)$$

$$T_2' = T_1' - \frac{X'}{D'}(T_1' - t_1') \qquad (19)$$

$$D' = Z' + \frac{X' + 1}{2} \qquad (20)$$

The third classification, that of parallel flow is not commonly used in commercial exchangers. The formulas will be presented here to complete the picture.

$$X' = \frac{T_1' - T_2'}{t_2' - t_1'} = \frac{m'c'}{M'C'} = X\,\frac{m'c'M\,C}{m\,c\,M'C'} \qquad (21)$$

$$Y' = \frac{T_1' - t_1'}{T_2' - t_1'} = e^{(X'+1)/Z'} \qquad (22)$$

$$Z' = \frac{X'+1}{\text{Ln } Y'} = \frac{m'c'}{U'A'}$$

$$= Z \frac{m'c'U\,A}{m\,c\,U'A'} \quad (23)$$

$$D' = \frac{Y'(X'+1)}{Y'-1} \quad (24)$$

$$t_2' = t_1' + \frac{T_1' - t_1'}{D'} \quad (25)$$

$$T_2' = T_1' - \frac{X'}{D'}(T_1' - t_1') \quad (26)$$

The equations which have been derived may be used most easily by following a series of steps. These steps are outlined for the first two classifications but will not be given for the parallel flow equations. These could be developed along the same general pattern, however.

Steps in the prediction of new operating conditions on an existing exchanger.

1)* Calculate X, where $X = \frac{T_1 - T_2}{t_2 - t_1}$

2) Calculate Y, where $Y = \frac{T_1 - t_2}{T_2 - t_1}$

3) Get Z from Fig. 2 or $Z = (X-1)/\text{Ln } Y$

4)* Calculate X', where

$$X' = X \frac{m'c'M\,C}{m\,c\,M'C'} = \frac{m'c'}{M'C'}$$

5) Calculate Z', where

$$Z' = Z \frac{m'c'U\,A\,F}{m\,c\,U'A'F'} = \frac{m'c'}{U'A'F'}$$

6) Get Y' from Fig. 2 or $Y' = e^{(X'-1)/Z'}$

7) Get D' from Fig. 3 or $D' = (X'Y'-1)/(Y'-1)$

8) Calculate $t_2' = t_1' + \frac{T_1' - t_1'}{D'}$

*If X or X' defined by Items 1 or 4 falls between 0.9 and 1.10, a better result can be obtained by using the arithmetic mean rather than the log mean. The following procedure is recommended. If X falls within those limits continue with Item 2a, if X' falls within the above limits, continue with Item 5a.

NOTATION

A — Heat transfer surface area.
c — Specific heat of cold stream.
C — Specific heat of hot stream.
D — $\frac{T_1 - t_1}{t_2 - t_1}$
F — Correction factor for multipass heat exchangers.
m — Weight of cold fluid handled per unit time.
M — Weight of hot fluid handled per unit time.
P and R — Temperature difference ratios as used in reference 2.
q — Heat transferred per unit time.
t — Temperature of cold fluid.
T — Temperature of hot fluid.
U — Over-all coefficient of heat transfer.
X — mc/MC.
Y — $\frac{T_1 - t_2}{T_2 - t_1}$ for countercurrent flow, or $\frac{T_1 - t_1}{T_2 - t_2}$ for parallel flow.
Z — mc/UAF.
ΔT_m — Log mean temperature difference.

Subscripts

1 — inlet conditions.
2 — outlet conditions.

Primes (') refer to conditions after changes have been made in the operation of the original unit.

9) Calculate

$$T_2' = T_1' - \frac{X'}{D'}(T_1' - t_1')$$

1a) Use X as defined in Item 1 above.

2a) Calculate $D = \frac{T_1 - t_1}{t_2 - t_1}$

3a) Calculate Z, where $Z = D - \frac{X+1}{2}$

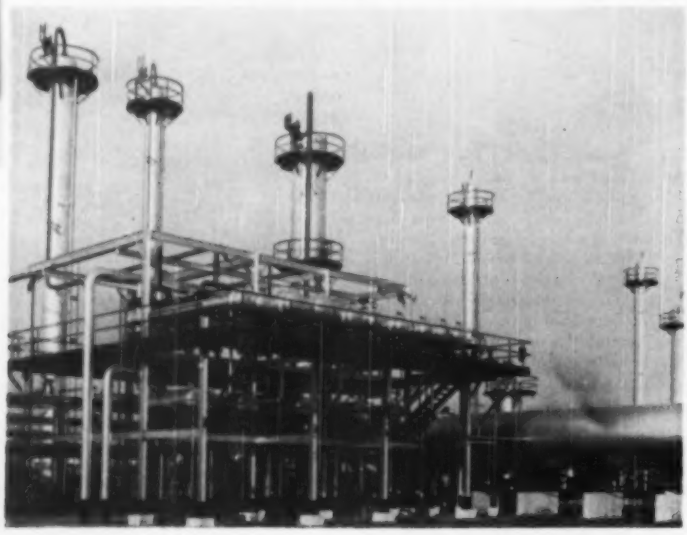
4a) Calculate X' as defined in Item 4 above.

5a) Calculate Z' as defined in Item 5 above.

6a) Calculate D', where $D' = Z' + \frac{X'+1}{2}$

7a) Calculate t_2' as defined in Item 8 above.

8a) Calculate T_2' as defined in Item 9 above.



Examples to illustrate some practical applications of the equations which have been developed are as follow:

Example 1.

A kerosine-to-crude-oil-exchanger in a refinery operates as follows. Kerosine in at 370° F. and out at 120° F. Crude in at 80° F. and out at 115° F.

A proposal is made to increase the crude oil charge rate by 25 percent and to make a diesel fuel in place of the kerosine. The yield of diesel fuel will be 50 percent greater than that of the kerosine and will enter the exchanger at 420° F. The crude will enter at 80° F.

Estimate the outlet temperatures under the new conditions.

Solution: This will be studied in a stepwise fashion.

1) $X = \frac{T_1 - T_2}{t_2 - t_1} = \frac{370 - 120}{115 - 80} = 7.15$

2) $Y = \frac{T_1 - t_2}{T_2 - t_1} = \frac{370 - 115}{120 - 80} = 6.38$

3) Z = 3.3 from Figure 2.

4) The change in specific heats will be neglected.
m'/m = 1.25
M/M' = 1/ 1.25 × 1.5
X' = 7.15 × 1.25/ 1.25 × 1.5 = 4.77

5) Film coefficients vary as the 0.8 power of the mass velocity.[4] Due to the increased crude oil rate, the crude oil film coefficient would be increased by $1.25^{0.8} = 1.195$. The diesel fuel film coefficient would be increased even more due to the increased yield. The resistance due to fouling and to metal resistance would be unchanged. Taking all these points into consideration a conservative figure might be a 20 percent increase in over-all transfer rate. There is no change in surface, and the small change in specific heats may be neglected.

Z' = 3.3 × 1.25/1.2 = 3.44

6) Y' = 3.0 from Figure 2.

7) D' = 6.65 from Figure 3.

8) $t_2' = 80 + \frac{420 - 80}{6.65} = 131°$ F. crude oil out.

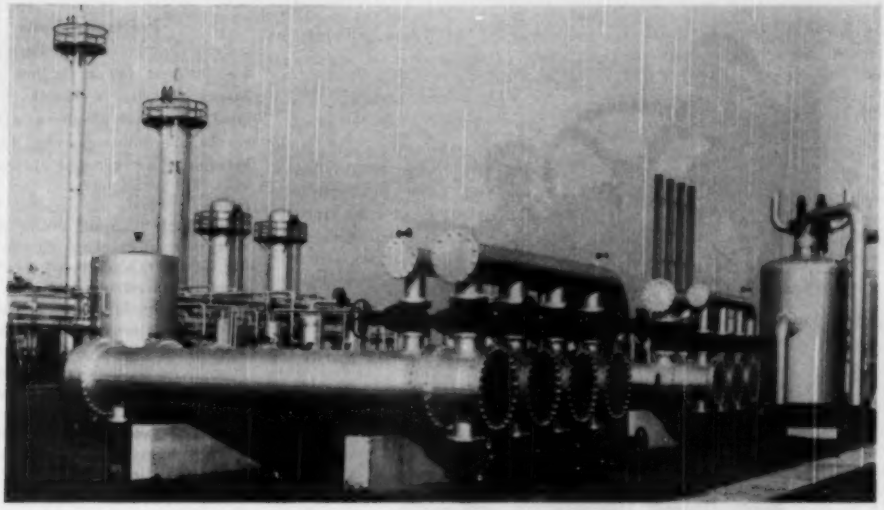
9) $T_2' = 420 - \frac{4.77}{6.65}(420 - 80) = 176°$ F. diesel fuel out.

Example 2.

In the new conditions of Example 1, how large must a second unit be in order to cool the diesel fuel to 120° F.?

Solution: This is the reverse of the above problem and must be handled in reverse order.

X' = 4.77 from Example 1.



$$D' = \frac{X'(T_1' - t_1')}{(T_1' - T_2')} = 4.77 \frac{(420 - 80)}{(420 - 120)} = 5.41$$

$Y' = 6.9$ from Figure 3.

$$Z' = \frac{3.3 \times 1.25 \times A}{1.20 \times A'} = 1.95 \text{ from Figure 2.}$$

$A'/A = 3.3 \times 1.25/1.20 \times 1.95 = 1.76$ or 76 percent more surface would be required.

Example 3.

A lean oil chiller consists of a U-tube bundle submerged in liquid propane which is boiling at 40° F. The lean oil enters the tubes at 90° F. and is cooled to 55° F. To what temperature could the oil be cooled if the propane temperature was reduced to 20° F. Assume 5 percent reduction in over-all coefficient due to higher viscosities.

Solution: In this case the coldest material does not change in temperature at all and the equations as developed lead to erroneous conclusions. The symbols for the cold stream and hot stream will be reversed in the following analysis.

1) $X = \frac{40 - 40}{55 - 90} = 0$

2) $Y = \frac{40 - 55}{40 - 90} = 0.30$

3) $Z = 0.83$

4) $X' = 0$

5) $Z' = 0.83 \times 1.0/0.95 = 0.875$

6) $Y' = 0.32$

7) $D' = 1.47$

8) $t_2' = 90 + \frac{20 - 90}{1.47} = 42.4°$ F. lean oil out.

Example 4.

An aftercooler on an air compressor cools air from 125° F. to 95° F. while heating water from 85° F. to 100° F. in countercurrent flow. It is estimated that if the water flow is cut in half, the transfer rate will only be reduced 10 percent since the air film is controlling. What outlet temperatures will be encountered if the water flow is reduced to half the original rate?

Solution:

1) $X = \frac{125 - 95}{100 - 85} = 2.0$

2) $Y = \frac{125 - 100}{95 - 85} = 2.5$

3) $Z = 1.09$

4) $X' = 2.0 \times \frac{1}{2} = 1.0$

Since this value is between 0.9 and 1.1, the arithmetic mean alternate will be used starting at this point.

5a) $Z' = 1.09 \times \frac{0.5}{1} \times \frac{1}{1} \times \frac{1}{0.9} \times \frac{1}{1} = 0.605$

6a) $D' = 0.605 + \frac{1 + 1}{2} = 1.605$

7a) $t_2' = 85 + \frac{125 - 85}{1.605} = 110°$ F. water out.

8a) $T_2' = 125 - \frac{1 \times (125 - 85)}{1.605} = 100°$ F. air out.

Example 5.

An oil-to-oil exchanger in an absorption plant consists of three units of two-shell pass, four-tube pass exchangers, connected in series and with the streams flowing countercurrently. The rich oil enters at 100° F. and leaves at 370° F. while the lean oil enters at 405° F. and is cooled to 140° F. The lean oil is in the tubes.

What operating temperatures can be expected on the remaining two if one unit is removed to be used in another service?

Solution: Since this is a multipass exchanger, the factor F developed by Bowman, Mueller and Nagle must be taken into account. The original unit has six shell passes and 12 tube passes. The factor F is found by use of the following ratios.

$$R = \frac{(100 - 370)}{(140 - 405)} = 1.02$$

$$P = \frac{(140 - 405)}{(100 - 405)} = 0.87$$

$F = 0.70$ from reference 2.

F' = can only be obtained by knowing the final conditions and therefore necessitates a trial-and-error solution.

1) $X = \frac{405 - 140}{370 - 100} = 0.98$

2a) $D = \frac{405 - 100}{370 - 100} = 1.13$

3a) $Z = 1.13 - \frac{0.98 + 1}{2} = 0.14$

4a) $X' = 0.98$ since there is no change in flow rate.

5a) Assume no change in over-all coefficient and as a first approximation, no change in F.

$Z' = .14 \times 3/2 = .21$

6a) $D' = .21 + \frac{0.98 + 1}{2} = 1.20$

7a) $t_2' = 100 + \frac{405 - 100}{1.2} = 354°$ F.

8a) $T_2' = 405 - \frac{0.98}{1.2}(405 - 100) = 156°$ F.

As a check, F' must be calculated. The unit in the second case has four-shell passes, eight-tube passes.

$$R = \frac{100 - 354}{156 - 405} = 1.02 \text{ unchanged.}$$

$$P = \frac{156 - 405}{100 - 405} = 0.815$$

$F' = 0.72$

This is close to the assumed value and further adjustments lead to corrections of about one degree.

The lean oil will leave at 155° F. and the rich oil will leave at 355° F.

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[1] McAdams, W. H. "Heat Transmission," McGraw-Hill Book Co., New York, 1942.

[2] Bowman, Mueller and Nagle, "Mean Temperature Difference in Design," Trans. of A. S. M. E., 62, 283 (1940).

ACKNOWLEDGEMENT

The three photos accompanying this article are used through courtesy of Western Supply Company, Tulsa.

Pernis Refinery Outstanding Example of Private Enterprise In Postwar Europe

THE $18 million Caltex refinery at Pernis, 8 miles from Rotterdam, Netherlands, which was officially opened on May 12, was conceived and built before ECA came into effect, is said by officials to "have few, if any, equal accomplishments by private enterprise in postwar Europe." The plant will operate on American-controlled crude oil from the Persian Gulf.

Officials of California Texas Oil Company Limited term the refinery "the most modern in all of Europe." It covers 104 acres of built-up land supported on 2400 reinforced concrete piers each 14 feet square and 35 to 100 feet long.

Gasoline, power kerosine, automotive kerosine, automotive and industrial diesel oils and fuel oils will be manufactured. To provide crude oil for the refinery's operation, Caltex must arrange for a large ocean-going tanker to arrive at the port of Rotterdam every fourth day.

"The original decision for construction of this plant was made in July 1947, and the refinery was started well before ECA came into effect," a company statement says. "It is an outstanding example of the way in which American private capital can assist in raising the standards of living of the people of the world through development of industry and transportation. World trade beneficial to all who participate could be well advanced if it were possible for American private enterprise to become partners in the development of less fortunate lands.

"The Caltex-Bahrein group of companies designed and started the construction of this plant entirely on its own; although Netherlanders frequently refer to the project as 'the little Marshall Plan,' no ECA funds were employed. The Netherlands government has been extremely helpful in every possible way, as they believe the Caltex refinery project to be one of the greatest forward steps yet taken in the Netherlands to accomplish their objectives for the economic and resulting social well-being of their people."

More than 250 houses for Pernis refinery workers have been completed in a suburb and plans are underway for construction of a number of larger houses for the supervisory personnel.

Processing Units

Processing units of the Pernis refinery are designed for a thruput of 20,000 barrels per day of Middle East (Abquaiq) crude oil. Products of the refinery include motor gasoline, illuminating kerosine, power kerosine, automotive and industrial diesel oils and fuel oils. The processing units consist of a two-stage atmospheric vacuum crude distillation unit, thermal cracking, thermal reforming, SO_2 (Edeleanu type) treating, polymerization, rerunning, and an auxiliary sweetening, inhibiting, and ethylizing. Facilities are provided for process steam generation, cooling water, product shipping by barge, tank car, and tank truck, laboratory control testing, administration, fire and safety control, employee services, and plant equipment maintenance.

The crude distillation unit is designed for a crude thruput of 22,500 barrels per day. With an operating factor of 90 percent, this capacity provides a thruput of 20,000 barrels. Design of the atmospheric and vacuum columns of the unit permit separation of crude oil into fractions of one whole gasoline cut, one kerosine distillate, one cut each of light, medium, and heavy diesels, a heavy waxy gasoil, and residuum. Minimum residuum yield is 9 percent of crude—a low yield to supply heavy waxy gasoil for thermal cracker charge stock, and low pour point fuel oils. Process design calculations demonstrated that such a low residuum yield was attainable in a two-stage distillation system without excessive equipment sizes. The heavy waxy gasoil production, it is expected, will be charged regularly to the thermal cracker, but other diesel distillates may be routed to either cracker charge or diesel blending, depending on the stock situation and market demands.

This unit is equipped with naphtha rerunning facilities to separate light straight-run naphtha for direct sweetening and blending into motor gasoline. In normal operations, bottoms from the rerun column will be charged to the thermal reformer, but provision has been made to produce a heart-cut heavy gasoline for the manufacture of tractor power kerosine.

A stabilizer is provided for debutanization (or depropanization depending on finished gasoline vapor pressure) of the light straight-run naphtha.

Thermal Cracking

Thermal cracking in the refinery is provided by a two-coil unit handling 7500 barrels per day of 20-25° API gravity heavy waxy gasoil charge. It has been designed with sufficient flexibility and latent overcapacity to meet greater demands for motor gasoline or to absorb higher than the design volume of gasoil into gasoline and fuel oil products.

A stabilizer in the unit debutanizes the cracked naphtha for vapor pressure control and recovers propylene and butylenes for polymerization. The unit produces a 400° F. endpoint motor gasoline and a residuum (cracked tar) suitable for blending into fuel oil. The depth of cracking can be varied over a reasonable range to assist in balancing over-all refinery operations.

Thermal Reforming

Heavy straight-run naphtha is charged to the thermal reformer at the rate of 7000 barrels per day. This unit, like the thermal cracking unit, is over-designed to meet abnormal short term gasoline demands. The unit is equipped with towers for vapor phase clay treatment of reformed naphtha, and a stabilizer for vapor pressure control and the recovery of propylene and butylenes for polymerization. Charge for the unit are the rerun column bottoms from the crude distillation unit of approximately 35 CFRM clear octane. Design of the unit incorporates adequate flexibility in reforming severity to permit variation of the product octane number over a reasonably wide range up to approximately 70 CFRM clear octane. A small yield of reformer tar is disposed of in fuel oil blending.

Polymerization Unit

In the polymerization unit, liquid phosphoric acid is employed as catalyst for the conversion of propylene and butylenes from the thermal cracking and reforming units to motor gasoline polymers. This unit processes the maximum combined olefin production from the thermal cracker and reformer. Auxiliary feed preparation equipment de-ethanize and remove hydrogen sulfide and mercaptans from the charge to the unit. De-ethanization prevents formation of a stable ester, produced by action of the catalyst on ethylene, which inactivates the catalyst. Reactor effluent is stabilized in two steps—depropanization followed by debutanization. The depropanizer overhead provides "sweet" propane for the refinery fuel system, and the debutanizer overhead is "sweet" butane used for vapor pressure control of motor gasoline.

SO_2 Treating and Rerunning

Aromatics and sulfur is removed from the kerosine distillate to produce high quality illuminating kerosine in the SO_2 treating unit of the Edeleanu type. It is anticipated that this fuel will also meet British jet fuel specification. Excess capacity of the unit provides a reasonably high degree of flexibility for either product. Extract from the plant, relatively high in octane rating due to the aromatic content, is rerun for use in power kerosine. Excess extract is either rerun for motor gasoline or routed to fuel oil cutter stock. The rerun unit handles extract and raw polymers on blocked operation.

Sweetening, Inhibiting, and Ethylizing

Used in the plant are three lead sulfide sweetening units for light straight-run reformed naphtha, 7000 barrels per day; cracked naphtha, 4000 barrels; and illuminating and power kerosine, 2050 barrels. These units were sized for the normal light straight-run naphtha from the crude distillation unit and the naphtha produced from the thermal cracker and reformer at maximum capacity. The kerosine unit is sized to sweeten the anticipated maximum production of kerosine or power kerosine.

Facilities for inhibiting and ethylizing the combined capacities of the two motor gasoline sweetening plants, 11,000 barrels per day, are provided.

Layout of the Caltex Refinery, near Rotterdam, Netherlands, is shown in this airview. Tanks are in foreground. In center foreground are shown, left to right, the utility rerun unit and the crude unit; behind these at the left of the two big stacks is the thermal cracking unit and, to their right, thermal reforming. The next row of units, going toward the water's edge, include left to right, those for reformed gasoline sweetening, cracked gasoline sweetening, kerosine sweetening, chemical plant, polymer plant, the polymer feed preparation and the SO_2 treating plant (the latter in the three-story building). Just behind the SO_2 unit is the power plant and on to the right near the big crane may be seen the water cooling facilities. In the upper left are located the storehouse, office buildings, garage, machine shops and, along the water's edge, four dwellings. The next group of buildings to the right include the laboratory, octane laboratory, change house, inflammable stores, cafeteria and fire truck house.

Storage of LPG Fuels at Low Pressure

C. V. SPANGLER, J. F. Pritchard & Company, Pittsburgh

***THE LARGE** volume storage of light hydrocarbons on solid adsorbents at reduced temperatures has passed the point of experimentation. Currently, operations of a pilot plant indicate that propanes and butanes can be efficiently handled in this manner while in transport by rail, tanker or barge.*

A further result of this pilot plant work is a confirmation of the feasibility of using a granular adsorbent in an above-ground storage container for the stock piling of natural gas.

THE stock piling of propane, butane and related hydrocarbons, and of natural gas, on solid adsorbents is an important technological development that has been achieved through the combined efforts of The Floridin Company, Warren, Pa., and J. F. Pritchard & Company, Kansas City, Mo.

Not too many years ago, there were no tankers to transport propane or butane. Neither were there large "tank farms" for these fuels. But, as the fuel use skyrocketed, the handling and transportation of propane and butane became a more vital issue.

Careful planning has brought most of these newer storage and transportation facilities through 1949 and into 1950 with little or no difficulty. However, it is incorrect to assume that the potential hazards are any less today than they were in 1940.

With larger and larger quantities of these fuels being concentrated in above-ground tanks, or in the holds of vessels, there is a very definite danger. That hazard is just as severe as that well appreciated for liquid methane storage. The pilot plant at Warren has indicated methods that may well provide a much greater degree of safety for the future.

The pilot plant consists of compressing and drying equipment, refrigeration machinery, heat exchangers, expansion valves and pertinent accessories. The heart of the plant is an adsorbent bed. This bed is well insulated and completely surrounded by a steel outer jacket.

"Methanite," the commercial name of the material used, is the registered trademark of The Floridin Company for the granular adsorbent which was initially the very familiar fuller's earth. This natural mineral is specifically prepared for this stock-piling process.

Fuller's earth is found in great quantities over a wide area of Florida and Georgia. Hundreds of tons are open-pit mined annually.

The adsorbent is inexpensive to produce and to prepare, as compared with other minerals of its general class and usage. Experience indicates an indefinitely long life for this service. In fact, where adsorbents are subject to contamination in use, LPG fuels are frequently used for their purification.

Figure 1. Two quarts of liquid methane burns violently in a matter of seconds when ignited.

At the pilot plant the dry fuel is chilled and expanded until it partly becomes liquid. The liquid is introduced directly on the top of the adsorbent bed. Only enough liquid is present to fill the necessary piping. This is not enough to create any undue hazard. The liquid works its way down through the bed until it becomes adsorbed. Studies at the pilot plant indicate good distribution throughout the granular adsorbent.

One cubic foot of adsorbent adsorbs at full capacity 300 standard cubic feet of methane. The adsorbent appears wet but does not contain any liquid which can flow, should the adsorbent be spilled out of a container and onto the ground.

Methane can be, and is, only released from the adsorbent as a gas just as fast at the latent heat of desorption is transferred to it from its surroundings. In practice the desorption of methane from the granular adsorbent is accomplished by circulating a warmer gas through the bed.

The granular adsorbent greatly slows up the heat transfer for desorption—if the adsorbent is exposed as a pile—as it might be if spilled out of a container.

To prove the inherent safety of this new method, liquid methane was poured into one trough and the same quantity of methane adsorbed on the adsorbent was released into an-

other trough.

Visitors at a recent "open house" at the pilot plant saw the liquid methane ignited—flash into violent flame, and die out. (See Figure 1.) There was much quieter burning when the other material was ignited, and there was a settling to a small and longer-lasting flame.

Another test had the granular adsorbent, fully charged, placed on fireproof insulation in a pile that was 8 inches wide and 4 inches high. This pile started to release vapor as it picked up latent heat for desorption from the air and the insulation. On ignition, the first release of gas burned rapidly. However, the fire soon settled down to a lazy flame which was only a few inches high. (See Figure 2.) Over an hour or more the flame gradually died down and eventually extinguished itself.

Such tests proved that the adsorbent had good insulation properties which prevented the latent heat needed for desorption from penetrating the pile at a rate sufficient to keep gas release and combustion going.

There is every indication from the experiments at the pilot plant that if there was a major break in a commercial application where a storage container might be broken the charged absorbent would burn off to a depth of only a few inches before extinguishing itself.

Engineers viewing such demonstrations voiced the opinion that there was no more hazard in a commercial adaption of the process than there is currently found in any normal gas or oil plant operation. They felt there was considerably more safety in this process than in many current phases of handling and transporting light hydrocarbon fuels.

Since the new method is now ready for commercial application, it appears that it has a definite possibility for adaption into the designs of ocean tankers and river barges.

If the process is practical for aboveground permanent storage, it should also find application for barge or tanker service. The granular adsorbent could be arranged in steel boxes or other containers of practical shape.

These boxes would, of course, have to be gas tight at a low-gas pressure. They would have to be vented to a pipe header. There would have to be sufficient insulation.

Propane could be charged into these boxes at a shipping termal with the fuel at its atmospheric pressure boiling temperature, —44° F. Some leak of heat through a fireproof insulation into the adsorbent bed might be expected. This would cause a desorption or release of some propane vapor. This could be carried away through a vent—and could be used as a fuel.

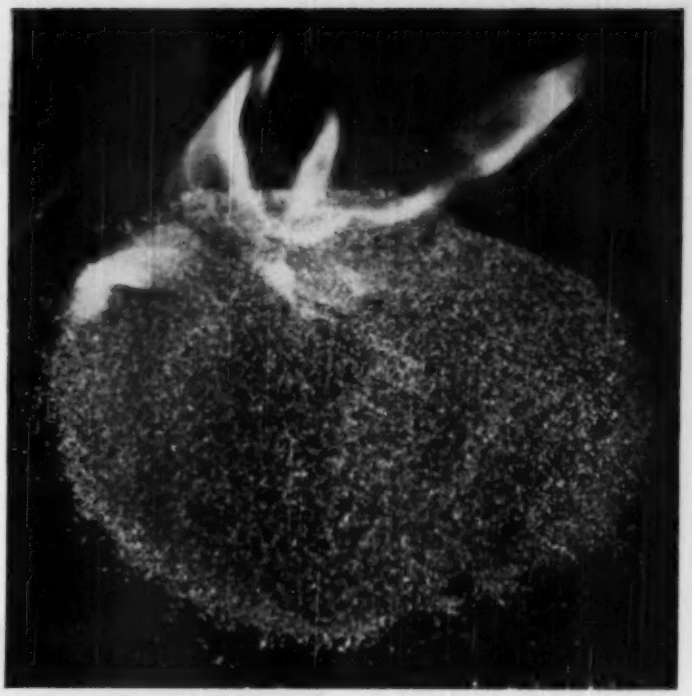


Figure 2. Two quarts of methane on a granular adsorbent burns quietly over a period of hours.

Such release, of course, would be proportionally small to the volume of light hydrocarbon fuel being transported. At this time it does not seem practical to consider the installation of refrigeration equipment to overcome the probable small heat leak.

Unloading a Tanker

When the vessel arrived at its destination terminal, the adsorbed propane could be unloaded by passing warmer propane vapor through the bed of granular adsorbent in the container. This operation might be accomplished right on the barge or tanker. Or, the containers might be designed to be removable. They would be swung out of the vessel and placed on shore for the desorption.

If butane was transported in this suggested manner, there would be less heat leakage since its boiling point of plus 31° F. creates a lower differential from atmospheric temperature. Naturally, less vapor release could be expected.

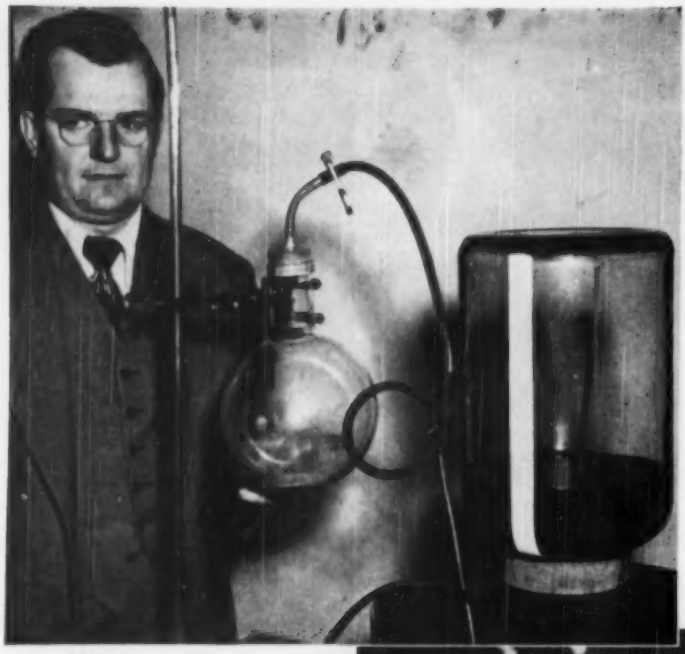
When it comes to railroad transportation, there are other apparent hurdles. The procedure described for water transportation would not be practical for there appears to be no easy method to dispose of heat leak vapors, nor an alternate practical

TABLE 1

Properties and Adsorption Characteristics of Light Hydrocarbons

	Boiling Point °F. Atmosphere	Heating Value per Scf. Gas Dry Basis	Scf. Gas per cf. of Liquid	Scf. Gas Stored per cf. of Adsorbent	Thousands of B.t.u., per cf. Liquid	M-B.t.u. per cf. Stored on Adsorbent
Methane	—259	1012	635	300	630	304
Ethane	—139	1762	430	207	758	364
Propane	— 44	2309	313	150	785	376
Butane	+ 31	3261	238	115	779	366

Note that in all cases on a B.t.u. basis, approximately 48 percent as much B.t.u. can be stored by adsorption, as can be stored as liquid



J. W. Moore, Floridin Company engineer, demonstrates 6 liters of propane being evolved from 40 cc of "Methanite" in the flask.

facilities in areas of high population.

Today, "tank farms" of from 20 to more than 100 tanks, each filled with liquid propane, present a substantial hazard. There have been a few fires at such installations. Casualties have not been entirely missing. Codes are being modernized in light of what is being learned about this method of storage. However, with the extension of existing storage to larger and larger quantities—many times in populated areas—there is a real potential danger. Storage on adsorbents would greatly reduce the hazard to surrounding area, for the simple reason that escape as a liquid is impossible.

The new process has interested insurance companies, and the pilot plant has proved completely theories and experiments for several years believed practical.

method of applying refrigeration during transit.

However, granular adsorbent could be installed in conventional pressure tank cars. During movement by rail there would be a slight pressure increase. The advantage would be a definite drop in fire hazard as compared to present methods of rail transportation—when there is a pile-up of cars on the track in case of a rail accident.

As an alternate, the same pressure storage method with adsorbents might be applied to tankers and barges to avoid vapor release. Again, the safety factor during shipment would be considerably higher than for the conventional liquid propane shipment. In case a fire broke out on board in open water, the possibility of its spreading would be small, and it could be extinguished with conventional means.

Coming back to the storage or stock piling of light hydrocarbon fuels in a permanent, fixed location, the pilot plant demonstrations revealed another attribute for the granular adsorbent process. Visitors at the initial demonstration believed the new process was a most practical answer to the problem of obtaining approval from insurance organizations and regulatory authorities for the construction of storage

E. W. Burt, field engineer for J. F. Pritchard & Company, at the control panel of the pilot plant at Warren, Pa.

Characteristics of Ring Balance Mechanical Flow Meters

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***METERING** problems of unusual interest to instrument engineers suggest that both the requirements of the installation and their solution require consideration of instrument characteristics which are not encountered in more conventional installations. In this discussion of the characteristics of the ring balance mechanical orifice flow meter, several unusual applications of the meter are discussed.*

THE ring-balance flow meter is basically a radial torque meter which utilizes a hollow ring body to convert differential pressure into a rotation, which is transmitted to the recorder or indicator.

The ring assembly of a typical flow measuring system is shown in Figure 1. The ring position at zero flow is shown in *A*, and the position at maximum flow is shown in *B*. The assembly is mounted on a knife-edge bearing, which permits rotation about the axis of the ring.

Two pressure compartments are formed in the ring by a baffle at the top and the sealing fluid at the bottom. The two compartments are connected to the pressure pipes through flexible tubing which permits free rotation in response to the action of the differential pressure. Ring rotation is transmitted to the recording or indicating element through the cam and suitable linkage.

Ring torque is a function of the differential pressure acting on the baffle. This torque is resisted by the leaf spring system located above the ring. The system is in equilibrium when the ring torque is balanced by the spring force.

The slope of the cam is gradual throughout, rather than being steep at the lower end. This provides high mechanical accuracy and sensitivity at low rates of flow.

The mercury, or other sealing fluid, acts only as a seal for the differential pressure in the two ring compartments and exerts no force tending to rotate the ring.

This ring balance meter has a number of special characteristics which warrant consideration for application to unusual problems.

Of first importance is the fact that

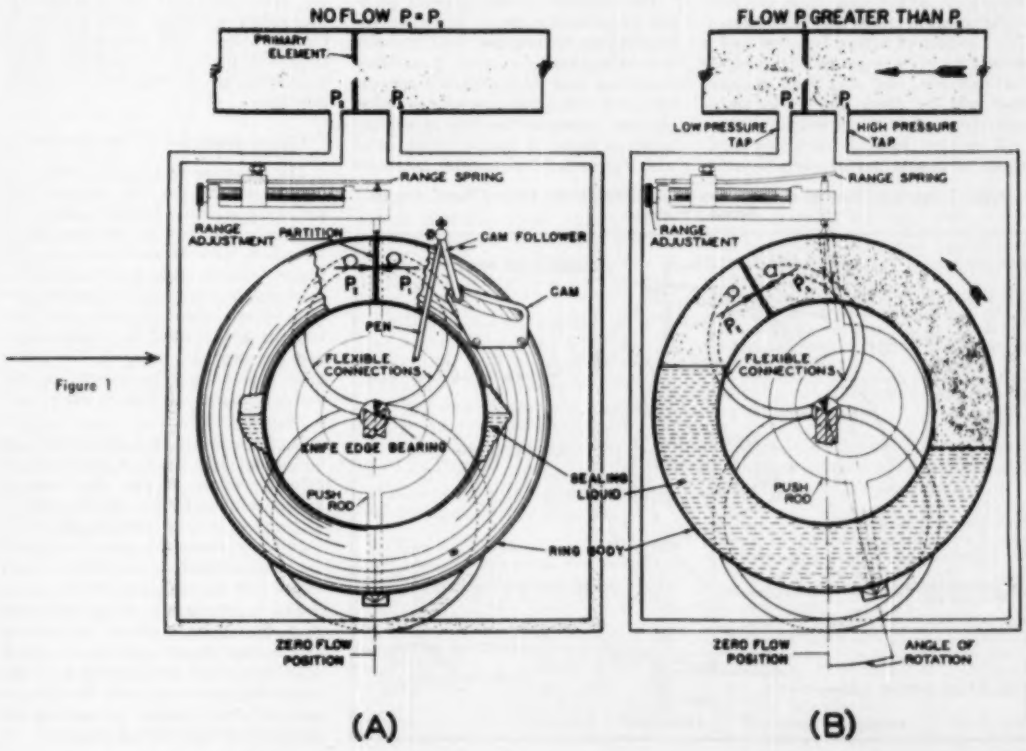


Figure 1

it is not a fixed head meter. The maximum differential corresponding to full scale pen deflection is adjustable over an appreciable range for any ring. A series of standard rings is available for a continuous range of maximum differentials for full scale reading from 0.5 inch to 420 inches water column. This permits considerable flexibility in the selection of the meter and orifice. At the same time, good readability and accuracy are maintained as maximum differential conditions are changed.

No Stuffing Boxes

A second feature is the absence of all stuffing boxes. Pressure parts are dependent only on size and the strength of materials used. The measurement of a maximum differential of, for example, 25 inches water column is made with equal ease and accuracy at a static pressure of 15 psig. or at 15,000 psig. Only the strength of the pressure parts is changed and basic design remains the same.

In addition, two rings may be mounted in a single case, with the separate pens registering on one chart. Either or both elements may be high pressure and high differential units or low pressure and low differential units.

The two measurements may be added or subtracted and the sum or difference integrated. At the same time, the individual measurements may be indicated. The product of a flow function and a second function may be obtained, as for example, one ring may measure flow and the other gravity in which case the product is net weight.

It is also possible to apply automatic compensation or correction for variations in pressure and temperature, either separately or simultaneously. The compensated record is then the correct record referred to the prescribed standard conditions. Manual correction is eliminated thereby. Automatic control from a compensated measurement is an exact control.

The method of correction is shown in diagram in Figure 2.

Each meter is supplied with check weights stamped with the water column equivalent. These are a part of the shop calibration, and provide the means for a simple and quick deadweight calibration at full operating pressure in the field at any time, without requiring high pressure manometers or other cumbersome testing equipment.

Since ring rotation is produced only by the action of the differential pressure on the baffle in the ring, it is not necessary that a column of mercury shall be moved to produce pen arm movement. The pen, therefore, registers each change in differential exactly and without overtravel. Large feeler lines are recommended, to assure rapid pen or pointer movement with any variation in flow.

The integrator is positioned by the pen arm, resulting in more accurate integration of variable flows.

The solution of one unusual problem involves the use of two standard instruments to measure heat transfer in a refrigerating system. A standard recording and integrating meter, equipped with a pressure compensating element, measures the flow of cooling water or brine. A second meter, fitted with a pneumatic transmitter, measures the difference in temperature of the fluid entering and leaving the cooler. The pneumatic signal from this instrument is proportional to the temperature difference, and represents the heat transfer per unit of fluid flowing through the cooler. The application of this signal to the compensating element of the liquid flow meter then represents total heat transfer in terms of Btu. or tons of refrigeration.

An installation which has required extreme sensitivity and accuracy is to control liquid level in a small reaction chamber under a static pressure of 15,000 psig. The chamber is approximately 6 inches in diameter and 24 inches high. Variable amounts of fluid enter at the top of the chamber, and level is controlled by a valve at the outlet. A standard mercury sealed ring balance meter, calibrated for a maximum differential of 12 inches of water column, feels the level in a section of the chamber which is ¾ inch in diameter and 4 inches high, and maintains the level within a maximum variation of one inch water column.

The controlled injection of an inhibitor in fuel oil for storage is an application requiring high accuracy of both measurement and control of the proportioned injection rate. This is accomplished with a standard recording meter, equipped with a pneumatic transmitter operated from a proportioning linkage. The pneumatic signal is used to position the variable stroke mechanism of the motor driven injection pump.

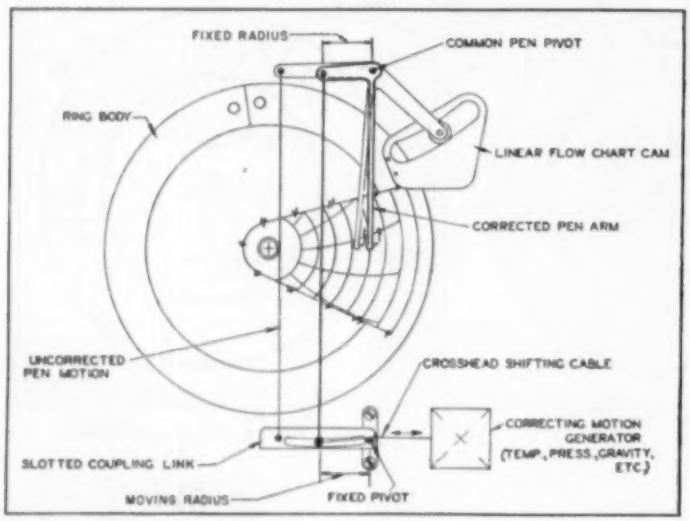
Characteristics of Installation

The characteristics of installations for measuring gas for repressuring wells are almost identical with those measuring the flow of refinery gas to a torch or flare. In each case, gas flow varies between zero to maximum almost instantaneously. Flow periods are of relatively short duration, and corrections are applied for temperature and pressure, as required. The meter must respond at a corresponding rate and integration of flow is made with a minimum error.

In the measurement of refinery gas on a total heat basis, it is usual that calorific value of the gas bears a known relation to the specific gravity. The use of a dual ring assembly, as previously discussed, permits recording and integrating in terms of corrected flow or total heat input.

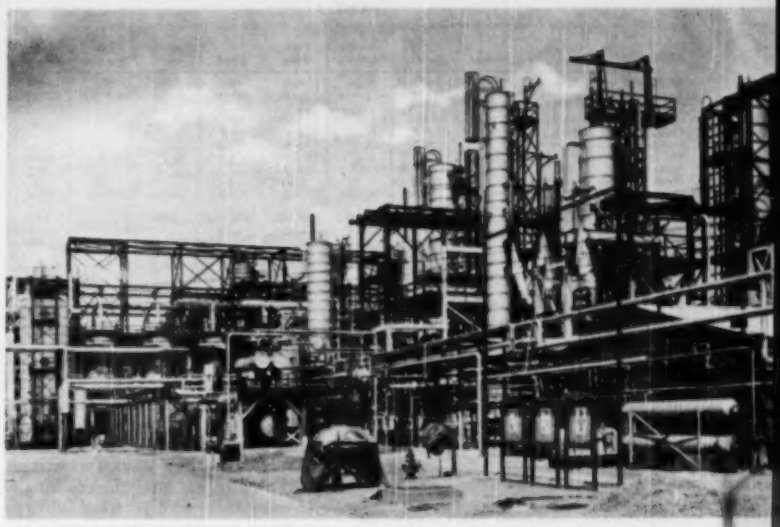
The modifications of the examples cited are almost infinite in variety, with prime dependence being placed upon sensitivity and accuracy of the measuring units over wide flow ranges and at such a speed as may be required by the particular process.

Figure 2. Schematic Diagram of Compensated Ring Balance Meter Showing How Corrected Record Is Produced.



IN VIEW of the higher octane requirements for motor fuel, to meet demands of automotive engines using higher compression ratios, catalytic cracking processes are of major importance to the refining industry for the conversion of medium and heavy distillate fractions. Earlier cat crackers had capacities ranging from 10,000 to 20,000 barrels per day. During the past few years of development, units have been built as small as 1500 barrels per day and as large as 40,000 barrels per day. The 1,000,000-barrel-per-day capacity of plants in operation at the end of the war has been increased up to the present time by nearly 800,000 barrels per day.

This discussion of the developments up through 1947 that have led to the status of the catalytic cracking processes provides a composite view of this phase of the refining industry. In addition, an excellent list of references permits detailed study of various portions of the subject.



Houdry Fixed-Bed Catalytic Cracking Plant at Sun Oil Company's Toledo, Ohio, Refinery.

Catalytic Cracking

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PART I

CATALYTIC cracking represents the largest single forward stride in the development of refining processes that the petroleum industry has made. Its importance to the industry is emphasized by the fact that "cat crackers" now have something over 1,700,000 barrels per day potential charge capacity, and in addition to representing the major current investment by the industry, these plants comprise approximately 25 percent of this nation's refining capacity.[1]

The most important result of catalytic cracking is the higher yield of improved products as compared to cracking by other and older methods.

The use of catalysts merely as accelerators of thermal cracking reactions cannot be justified commercially.[2] Without catalysts, the rate of thermal cracking reactions is very high at reasonable temperatures, and can be controlled easily by proper choice of cracking conditions. In catalytic cracking versus thermal cracking, the basic problem of merely accelerating a given reaction by means of catalysts is not encountered but rather that of promoting a distinct set of catalyzed reactions as opposed to another different set of thermal reactions. Heretofore in conventional thermal cracking practice, a sacrifice in yield was unavoidable to improve quality. Catalytic cracking, on the other hand, does not cause a decrease in output, but actually increases overall gasoline yield with a corresponding decrease in yield of residual fuel oil. Further, the octane number of the gasoline is improved by a substantial margin.

Studies on the catalytic cracking of pure hydrocarbons over a silica-zirconia-alumina catalyst similar to those employed in commercial cracking have produced some interesting generalizations on catalytic cracking[3] which help to answer the question: "Why Catalytic Cracking?"

As compared with thermal cracking, catalytic cracking gives rise to:

1) More selective cracking and less C_1 and C_2 products. This means that production of refractory overhead gases, which are often burned at a flare, is cut down—a definite economic advantage.

2) More olefin isomerization—both of the double bonds and of the carbon skeleton—occurs, producing a valuable, high-octane product gasoline.

3) A more controllable saturation of double bonds, particularly in the high molecular weight fractions.

4) Greater production of aromatics, giving rise to increased octane number of the product gasoline.

5) Less diolefin production. This leads to lessened gum formation in the gasoline product.

6) Relatively more coke, which is a disadvantage, but which may be taken care of quite neatly by burning the coke from the catalyst, followed by efficient utilization of the heat evolved.

7) The ability to tolerate high-sulfur feed stocks[4] due to the desulfurizing action of many cracking catalysts.

A simple classification of catalytic phenomena in the cracking of paraffin hydrocarbons is as follows[5]:

1) Some catalysts weaken C-C and C-H bonds and cause a complete decomposition of paraffins into carbon and hydrogen, or carbon, hydrogen, methane, and ethane. These are heavy metals such as Pt, Ni, Cu, and some others.

2) Some catalysts weaken C-C and particularly C-H bonds and produce a series of decomposition and condensation products. These include $AlCl_3$ (which is active even at low temperatures), $FeCl_3$, $ZnCl_2$, and some other chlorides of this type.

3) Some catalysts weaken C-H bonds and effect dehydrogenation of paraffins to olefins

TABLE 1

PROCESS	McAfee	Houdry	Houdry Adiabatic	Thermofor	Fluid	Cycleversion	Suspensoid	Hydroforming
REACTOR temp., F	500	900	1100	900	950	1000	1000	1050
Reactor top press., psig	15	30	—13 (Vac.)	10-15	10-20	35-100	400-500	150-300
Cat./oil ratio by wt.	.02-.10	.....	.....	1.0-5.0	10-20	.....	0.5	.....
Gasoline yield/pass, percent	.....	45	.....	45	45	.....	.....	.....
Coke formation, percent	5	1-5	.....	2-4	4-6	.....	.....	.....
Dry gas formation, percent	10	4-7	.....	6-8	7-12	.....	.....	.....
No. passes employed	Batch	1	1 or 2	1	1	1	1	1 or 2
Space velocity, V/V/hr.	.....	0.75-1.50	2.7	0.8-2.0	.....	2-4	.....	0.6
Steam in charge, percent	0	5-10	0	0-20	0	.....	0	0
On stream time	24-48 hrs.	10 min.	10 min.	Cont.	Cont.	3-6 hrs.	Cont.	4 hrs.
REGENERATOR temp., F	.....	900	1100	700-1100	1000-1100	1200	.....	1100
Regenerator top press., psig	.....	40	2-3	Atm.	1-10	.....	.....	170
Temp. of regen. air, F.	.....	750	1075	Atm.-1000	Atm.-1000	800-850	.....	700
Comp. of regen. "air"	.....	Pure air	Pure air	Pure air	Pure air	Air & Steam	.....	Inert gas 1.5% O_2
CATALYST composition	$AlCl_3$	SiO_2-Al_2O_3	Al_2O_3-Cr_2O_3	SiO_2-Al_2O_3	SiO_2-Al_2O_3	Al_2O_3	SiO_2-Al_2O_3	Al_2O_3-MoO_3
Phys. shape of cat.	.....	0-mesh Pellets	Pellets	Pellets or beads	300-mesh Powder	Pellets	—100-mesh Powder	Pellets

and include carbon, alumina, and chromic oxide.

4) Some catalysts weaken C-C bonds and perform splitting reactions, forming olefins and paraffins of a lower number of carbon atoms. These catalysts include the oxides and sulfides of molybdenum, vanadium, tungsten, and some other heavy metals. The action of these catalysts is less selective and they may catalyze dehydrogenation reactions also.

5) Some catalysts slightly weaken both C-C and C-H bonds and mildly accelerate all cracking reactions. These include the activated clays and some other adsorptive materials.

Commercial cracking catalysts used today fall largely into the last class.

In commercial practice the charge to a catalytic cracking unit consists of a narrow- or wide-boiling virgin coke distillate, a visbreaker gasoil, or a deasphalted residue[5] from which a 40-65 percent volume yield of gasoline is obtained. This gasoline product has an octane number of 78-82 (ASTM) or 88-95 (Research). This spread between ASTM and Research octane numbers is significant because it is indicative of superior road performance of the fuel which is the best index of actual motor fuel quality.[6]

Delayed coking and propane deasphalting have been utilized for feed preparation for catalytic cracking units.[7,8,9]

The economics of catalytic cracking are defined by a number of variables[5]:

1) Size of installation,
2) Type of charge stocks,
3) Number and quality of products other than motor gasoline which it is desired to produce,
4) Availability of means such as alkylation and polymerization for utilizing light fractions,
5) Refinery utility balances and costs,
6) Market demands and prices for products.

One economic comparison of various other processes with Fluid catalytic cracking[10] offers the conclusion that the only disadvantage of the catalytic process is that it has the highest installation cost of those processes compared. This was found to be counterbalanced by: a) the lowest cost per gallon of gasoline at all octane levels studied and b) reduced production of third-grade gasoline and bunker fuels.

Actual operating costs for various specific cases of catalytic cracking,[11] and catalytic cracking versus isoforming,[10] and catalytic cracking and alkylation, isomerization, and hydroforming[5] have been presented in the literature.

A summary of the characteristics of all of the catalytic cracking processes to be discussed in this series is presented in Table 1. It serves as an introduction to the detailed process descriptions which follow.

McAfee Process

This process is of interest only from the historical standpoint but is of definite interest because it was the first catalytic cracking process and the forerunner of all the modern processes to be considered later in this paper.

McAfee has described the process[12] and it is the subject of various patents.[13] A commercial unit was constructed at Port Arthur, Texas, in 1916 (17 years before the advent of Houdry cracking) but high aluminum chloride cost and the difficulty of catalyst recovery prevented its more extensive use.[14]

The McAfee process was carried out at about 500° F. and at atmospheric pressure in the presence of 2-10 percent of anhydrous $AlCl_3$. In one patent specification[15] (see **Figure 1**), a pot-type agitated iron still is employed. The still is charged batchwise with oil and $AlCl_3$ and is heated by direct fire until the charge boils at about 500° F. The product distilling from the reaction mass over a period of 24-48 hours passes through a series of air condensers whereby heavy oils are condensed and returned to the still and gasoline or gasoline plus kerosene pass overhead to a water-cooled final condenser.

Yields of gasoline up to 60 percent were obtained by the McAfee process using gas oils as charging stocks.[2] As high as 85 percent conversion of high-boiling oils into low-boiling oils was attained in the McAfee process[17] with 10 percent conversion to gas and 5 percent conversion to coke. This gas was suitable for fuel for heating the still.

Gasolines produced by cracking in the presence of $AlCl_3$ have relatively low anti-knock values, however,[16, 18] and therefore are not as satisfactory as those formed by thermal cracking.

Houdry Catalytic Cracking and Reforming

Historical Background

Eugene Houdry, starting about 1927, was one of the pioneers in the field of catalytic cracking.[19] As a result of his early investigations, he gained the strong backing of Socony-Vacuum Oil Company, Inc., and Sun Oil Company. This group working together through their respective research, development, and engineering organizations, attained notable success in developing catalytic cracking to the commercial stage. The first commercial Houdry units were placed in operation in 1936 at Paulsboro, N. J.

Some of the early background on fixed-bed cracking with adsorptive catalysts, such as clay,[19, 20, 21, 22, 23, 24, 25] is of interest at this point as an introduction to the discussion of the Houdry process.

The Houdry process[26] (see **Figure 2**) is carried out under low pressures of about 30 psig. in units comprising three or more catalyst vessels, called "cases," manifolded together by suitable piping and valves so that one or more of the cases may be on stream while the others are being regenerated.[18]

The catalyst chambers provide an efficient and uniform contact of the vapors with the catalytic mass. Vapors enter the catalyst mass through openings in a plurality of inlet tubes and leave through openings in outlet tubes.[27] The separation of the cracked products leaving the catalyst cases is the same as in other cracking processes.[4]

The thruput of gasoil in Houdry units equals approximately 1 volume of gasoil per volume of catalyst per hour or more. Rate or reaction time predetermines the properties of the gasoline as will be seen later.

Cracking is carried out in a once-through operation. A high yield of gasoline per pass (up to 45 percent) is accompanied, due to the high conversion, by considerable coke formation ranging from 1-5 wt. percent of the charge. Gas formation, on the other hand, is very moderate, ranging from

4-7 percent, which is less than would be expected on the basis of the above conversion.[2] This may be explained either by secondary reactions involving the gases formed, or by direction of decomposition reactions to the middle of paraffin chains.

Operating data on a typical Houdry units have been supplied in considerable detail.[28, 29]

Carbon Formation and Burning

The activity of the catalyst, of course, decreases during operation due to the deposition of carbonaceous materials. The operating cycles vary from 20 to 135 minutes in cracking gas oils. Regeneration of the catalyst is performed by oxidation with air at moderate temperatures. Regeneration restores the original activity of the catalyst and the actual operation of the same catalyst lasts over a year.

The heat produced in regenerating the catalyst by burning the carbonaceous deposit is recovered in the endothermic heat of the cracking reaction and as steam and electric power, through the medium of the heat-transfer salts which circulate constantly through the catalyst cases. The power recovered is sufficient for the electricity and steam requirements of the cracking unit. The combustion gas turbine has found wide application in power recovery from Houdry units.[30] Air for regeneration is supplied by an axial compressor, is preheated in a salt heat exchanger to 750° F. and introduced to the spent cracking case. It leaves at 800-850° F. at pressures above 40 psi., then passing through the gas turbine which drives the axial compressor furnishing regeneration air. A steam turbine utilizing steam generated by heat exchange with salt from the cracking cases and an electric motor-generator are on the same shaft as the gas turbine and the compressor, giving a very versatile setup.

According to Houdry,[31] the coke deposit should be below 15 g. per liter of catalyst to secure maximum yields and reduce the regeneration periods to 40 minutes or less. On the basis of commercial units with a capacity of 10,000 barrels per day, the amount of coke burned may vary from 20 to 120 tons per day depending on the type of operation being conducted.[18] As stated above, up to 5 percent of the charging stock may be converted to coke. However 1.1 wt. percent is the maximum allowable coke formation based on catalyst weight. This limit is set by regeneration temperature, poisoning effect of coke on the cracking reaction (13-18 percent halts it completely), and regeneration time.[32]

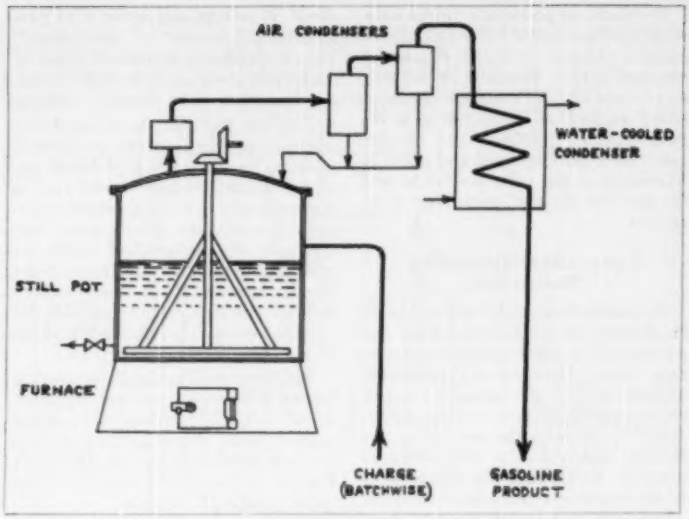


FIGURE 1

The heart of the Houdry plant (or perhaps better the brain) is the cycle timer.[22] In the control house adjacent to the cycle timer, each valve in the entire automatic system operates signal lights indicating its position. Electrical check circuits insure that every valve is in its correct position at all times. In the event that any valve fails to move to its proper position after the impulse has been given, the operation of the timer is stopped automatically and both visual and audible alarms notify the operator of the failure.

Two types of cycles have been employed in Houdry plants:

1) 3 cases—cracking time equal to regeneration time.

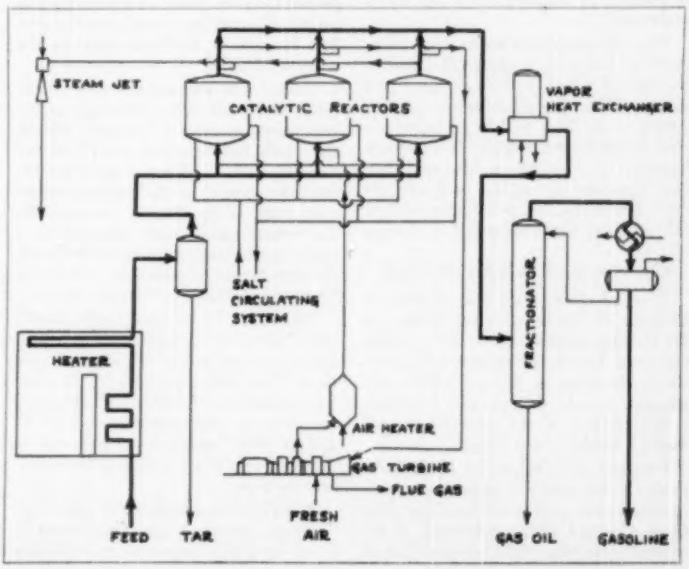
2) 4 cases—regeneration time twice as long as cracking time.

Two types of cycle timers have been employed in controlling valve sequences:

1) A 900-point dial type, making an impulse every two seconds. Impulses are transmitted via relays to motor operated valves.

2) A jack type employing a constant-speed worm screw (reversible) which raises and lowers a bar making the required series of contacts.

FIGURE 2



Hydraulic or pneumatic valves were eliminated because of failure to achieve positive closure, in favor of motor-operated valves. Venturi-type contractor sections enabled economies in valve selections such as in the use of a 16-inch valve in a 30-inch line. Wedge gate valves are employed and steam is introduced at the valve bonnet to seal the gate and prevent intermixing of air and oil.

Temperature Control by Molten Salt

Temperature control is of paramount importance in catalytic cracking and particularly in the regeneration operation, which liberates a considerable quantity of heat. An excessive regeneration temperature, exceeding 1000-1050° F. impairs the activity of the Houdry catalyst. The difficulties of properly controlling the temperature in the presence of adsorbent materials, which are poor conductors of heat, have been overcome by the use of efficient heat-exchange media such as fused salts, molten metals and alloys etc. which are circulated in finned tubes located in the catalyst chamber.

The salt heat-transfer medium employed in Houdry plants[33, 34] is a mixture of 40 percent sodium nitrite, 7 percent sodium nitrate, and 53 percent potassium nitrate and has a melting point of approximately 285° F.

Chemical changes in the heat-transfer salt involve the formation of carbonates from oil leaks into the salt system and the formation of nitrates by oxidation. Auxiliary equipment may be used[33] to remove the carbonates and to reduce the nitrates to nitrites using hydrogen.

The salt circulates under high vacuum[33] in order to avoid explosions in the case of a leak in the salt tubes in a reactor. Since the oil is under positive pressure any leak will be of oil vapor into the salt system where it will burn harmlessly. Also any oxides of nitrogen liberated from the salt are removed and the salt penetrates well to all parts of the heat-transfer system.

Chemistry of Houdry Process

Cracked residuum, in the customary meaning of this term, is not formed in the Houdry process due to the fact that the clay has a decarbonizing action which decomposes the asphaltic constituents to coke and gas oil. A considerable portion of the catalytic gas oil may be used as furnace oil.

Catalytic gasoils can be cracked repeatedly by catalytic operations, producing lower yields of gasoline than those obtained with virgin feed. In the second pass the yield of gasoline is about 30 percent and in the third pass is about 25 percent of the charge.[36] Thus the stability or refractoriness of the recycle stock increases with increasing operation, as in thermal cracking.

Catalytic gas oils can be used successfully as charge stocks for thermal cracking, producing high yields of gasoline. Houdry recycle stocks have a distinctly aromatic or naphthenic character. Due to their refractoriness, they are only slightly cracked under the mild temperature conditions of the Houdry process. High-temperature thermal cracking is more suitable for breaking down the cyclic hydrocarbons of Houdry recycle stocks.

Catalytic cracking produces gasoline having a low sulfur content. Approximately a tenfold reduction in sulfur content from charging stock to raw cracked gasoline is typical. The desulfurizing action of the catalyst is thus quite worthy of mention.

Catalytic gasolines are comparatively stable with respect to gum formation due to the polymerizing action of the clay on the unstable unsaturated hydrocarbons responsible for gum formation. As a result catalytic gasolines may be used as aviation fuels after a light treatment by sulfuric acid or after high-temperature clay treatment.

The Houdry process, using the activated clay catalyst, is performed at 900° F. or, in other words, at temperatures which are not much lower than are used in thermal non-catalytic processes. As might be expected, the catalytic action of the activated clay on the decomposition reactions is moderate. The main action of the clay, however, probably takes place in the secondary stages of cracking, involving the olefins formed in the first stage of the process.[2, 35, 36, 37]

Taking into account the great instability of olefins at high thermal cracking temperatures, it is not believed that olefin isomerization would play an important part in thermal cracking. On the other hand, in the catalytic processes such as the Houdry process, olefin isomerization may proceed to a large extent and may be utilized for the production of gasolines rich in the branched aliphatic hydrocarbons.

Alkylation of benzene with olefins takes place at moderate temperatures and pressures in the presence of activated clay giving high yields of alkylated benzenes. Schollkopf[38] alkylated naphthalene with ethylene at 230° C. and at 20-40 atmospheres pressure in the presence of an activated hydrosilicate catalyst.

Alkylation reactions of paraffins, yielding branched paraffins, seem to be of particular importance in Houdry cracking. As a result the content of unsaturates in Houdry gasolines is usually much lower than in ordinary cracked gasolines. It is of interest that the acid heat of a Houdry gasoline can be reduced from 68 to 9-21 by further treatment by the same process in the presence of clay.

The content of unsaturates in Houdry gasoline is higher with higher case temperatures and shorter contact times. It may reach values equal to those for thermally-cracked gasolines. This seems to indicate that the secondary reactions catalyzed by clay require much more time than the primary decomposition reactions catalyzed by the same catalyst. It is of particular interest that octane numbers of Houdry gasolines do not vary with degree of saturation. Longer contact times are used for the production of more stable aviation gasolines and shorter times when motor gasolines are manufactured.

Houdry gasolines have a low specific gravity showing that they do not contain a high percentage of aromatics. Thus the 78 octane number (ASTM Motor method) of Houdry aviation gasoline is attributed principally to branched paraffins and olefins. Naphthene dehydrogenation in Houdry cracking produces a higher hydrogen content of the cracked gases and a higher aromatic content of the gasoline than in conventional thermal cracking, of course.

Houdy Catalytic Reforming

Houdry processing techniques may also be applied to the reforming reaction.

Reforming is a cracking process for converting low-octane number naphthas or gasolines into high-octane number products.

Thermal reforming is carried out under rather severe conditions—1000° F. and 250-1000 psi. In contrast, Houdry reforming[39] is carried out at 900° F. and low pressure. When reforming naphthas in a Houdry unit,[40] the thruput rate is almost doubled as compared with cracking gas oils—to 2 volumes of naphtha per volume of catalyst per hour. The time of operation is ten minutes or more. Houdry reforming is accompanied by partial desulfurization.

The yield of catalytically-reformed gasoline exceeds that of thermally-reformed product by 5-10 percent for an equal improvement in octane number.[2]

Late Houdry Developments

Houdry fixed-bed catalytic processes are undergoing constant development[41] and continued improvemnt in mechanical features has resulted in on-stream time efficiencies of 90 percent.

When synthetic catalysts were first introduced, a minimum life of 12 months was anticipated. New synthetic catalysts have been operating for periods in excess of 15 months. Based on a service life of 15 months, a 10,000 barrel per day Houdry plant consumes an average of 650 pounds of catalyst daily.[41] Expressed in terms of thruput, this consumption averages one ounce of catalyst per barrel of charge.

Lower operating costs and increased gasoline production have been achieved in newer Houdry units.[42] The finned tubes employed in early designs had rather complicated interlocking fins. Redesign giving a geometrically simpler fin arrangement has effected marked economies in the discharge of spent catalyst due to improved catalyst flow characteristics. Also a granular chemically-inert mass may be mixed with the catalyst mass providing greater heat capacity in a reactor. Even though the catalyst is diluted with this inert material, overall case efficiency is not reduced because the simpler baffles previously mentioned have provided greater available catalyst space.

The use of bead catalysts originally developed for use in moving-bed Thermofor cracking units (to be described later) is the latest devlopment in Houdry cracking plants.[43] The free-flowing character of the round beads contributes materially to the ease of catalyst removal. The mechanical stability of the beads has reduced dusting of the catalyst. Temperature control is improved when using the bead catalyst and the cost of the bead catalyst is only 12 cents per pound as compared to 20 cents per pound for Houdry synthetic catalyst. This is an interesting example of a case where a material developed for a specific use (in the Thermofor process) has given new life to an old established process where its use was not originally intended at all.

In conclusion, it may be stated that the production of stable, high-octane gasoline is the main advantage of the Houdry process. The additional expenses in conjunction with the use and regeneration of the catalyst may be justified by the outstanding qualities of the gasoline product.

Houdry Adiabatic Catalytic Dehydrogenation

One of the latest Houdry developments and one which is worthy of separate mention, reflects a construction simplification eliminating the salt heat transfer system.

This development is called the Houdry adiabatic process since the catalyst case contains a medium for storing heat during the carbon-burning cycle which is used to supply heat during the reaction cycle.

The process can be applied to the cracking of first-pass catalytic naphthas and virgin heavy naphthas and produces base stocks which vary from 93 to 99 (AFD-1C) with 4 cc. of lead and have excellent rich-mixture characteristics. It offers excellent possibilities for processing gasoils and reduced crudes.[44]

However, this adiabatic process has found application mainly to the catalytic dehydrogenation of paraffin hydrocarbons to the corresponding monoolefins and diolefins, and specifically to the manufacture of butadiene from butane **(Figure 3).**

Application of the process to butadiene manufacture consists either of processing butane through two stages of dehydrogenation or of processing butane-butene feed through one stage of dehydrogenation. In each type of operation, purification of the butadiene consists of separating it from other hydrocarbons by solvent extraction. Here the butadiene is picked up by the solvent while other hydrocarbons are released for recycling back through the dehydrogenation process. Finally solvent and butadiene are separated and the butadiene is ready for storage.[45, 46]

(End of Part I. Part II will appear in an early issue.)

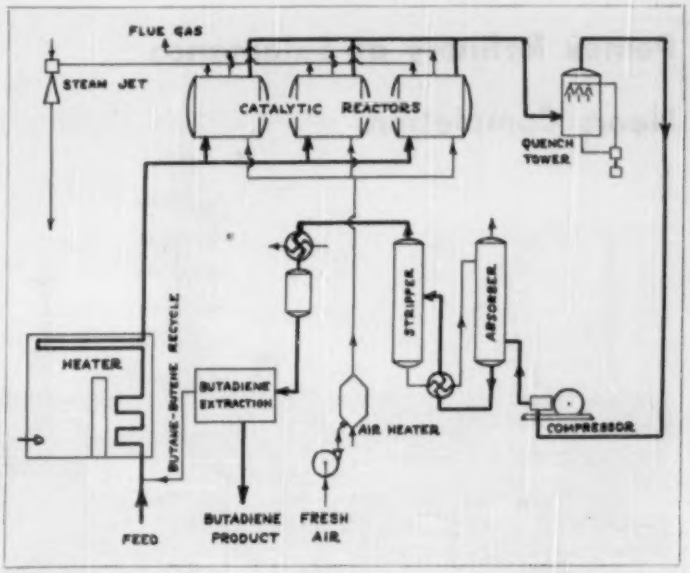


FIGURE 3

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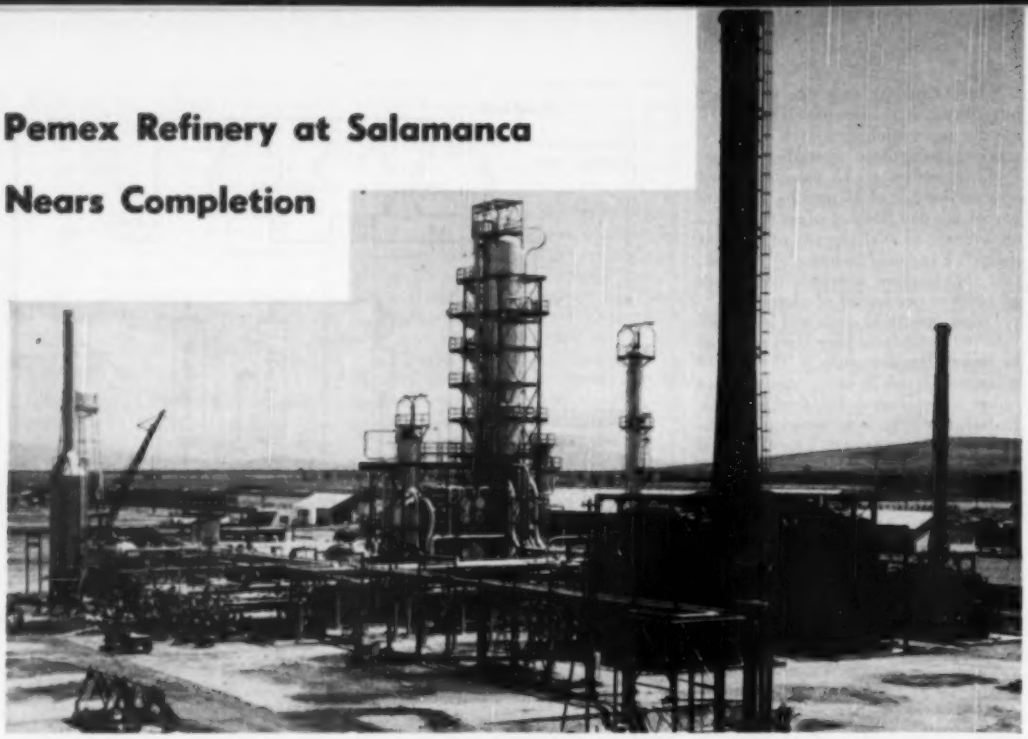
Pemex Refinery at Salamanca Nears Completion



Atmospheric Crude Distillation Unit: Design charge capacity is 30,000 barrels per stream day of enriched Poza Rica crude oil. This unit produces four primary products: unstabilized straight-run naphtha, kerosine, gasoil, and topped crude. It is essentially a duplicate of a unit at Mexico City which has been in operation for more than two years.

Nation's Oil Economy Expects Two-way Stretch With Opening of Plant

THE $12 million refinery which Petroleos Mexicanos will soon complete at Salamanca, 180 miles northwest of Mexico City, and the new $11 million pipeline which will supply it with Poza Rica crude oil, will give a two-way stretch to Mexico's supply and distribution of oil.

First, it will add 30,000 barrels per working day to the nation's supply of products.

Second, and even more important, it will provide this new supply in the region where consumption is greatest.

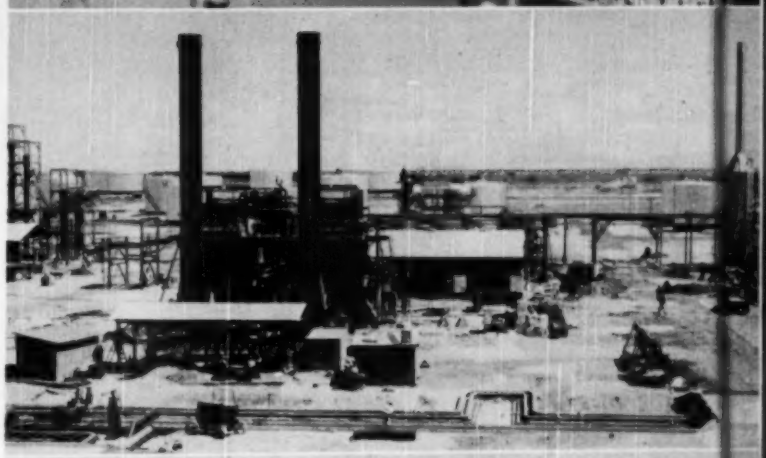
Senator Antonio J. Bermudez, director general of Pemex, points out that the new installation will raise Mexico's refining capacity by 17 percent; but that, of greater significance, it will step up refinery output in the elevated tableland area of central Mexico, where 58 percent of the national demand exists, by 60 percent.

This 60 percent improvement derives from the fact that the sole direct supply of refined products for this area now comes from the Atzcapotzalco refinery at Mexico City, which has a capacity of 50,000 barrels per working day. The addition of 30,000 barrels a day will make

Thermal Cracking Unit: Design charge capacity is 4000 barrels per stream day of gasoil produced in the crude distillation unit. Alternate charge capacity is 3000 barrels of gasoil plus 1540 barrels of topped crude. This unit includes vapor recovery equipment and produces dry fuel gas, propane (LPG), butanes (for vapor pressure blending or liquefied petroleum gas), cracked gasoline (debutanized as desired) and cracked residuum (fuel oil). Design charge capacity of the catalytic desulfurization unit is 8850 barrels per stream day of unstabilized straight-run naphtha produced in the crude distillation unit. Alternate charge capacity is 11,600 barrels per stream day of mixed straight run and cracked naphthas. The naphtha stabilizer unit removes propane, hydrogen sulphide, and lighter components from the product of the catalytic desulfurization unit.

General site facilities (top photo at right) include buildings for administration and attendant services; maintenance facilities such as carpenter shop, machine shop, welding shop, etc.; motor trucks and their garage and shop; fire fighting facilities; railroad trackage and sidings; refinery control laboratories, etc. Electric generator plant in foreground.

Refinery steam and power facilities: The steam plant (center photo at right) consists of two boilers, each having a rated capacity of 60,000 pounds per hour of 275 psig steam, together with one 3000-kw. condensing turbo generator. Also there are three diesel-engine-driven generators, each having a rating of 540 kw. at the Salamanca elevation.



a big difference.

"Even with this new addition, over-all geographical demand for products and available refining capacities are not in balance, although a considerable betterment is obtained for distribution of petroleum products," Bermudez explained.

"Until the present, the installed refining capacity for the high central zone, as represented by the Atzcapotzalco refinery, has been 27.5 percent of the total installed refining capacity of the nation. The Salamanca refinery brings this proportion up to 38 percent, as against the demand for this region of 58 percent of the total national requirements.

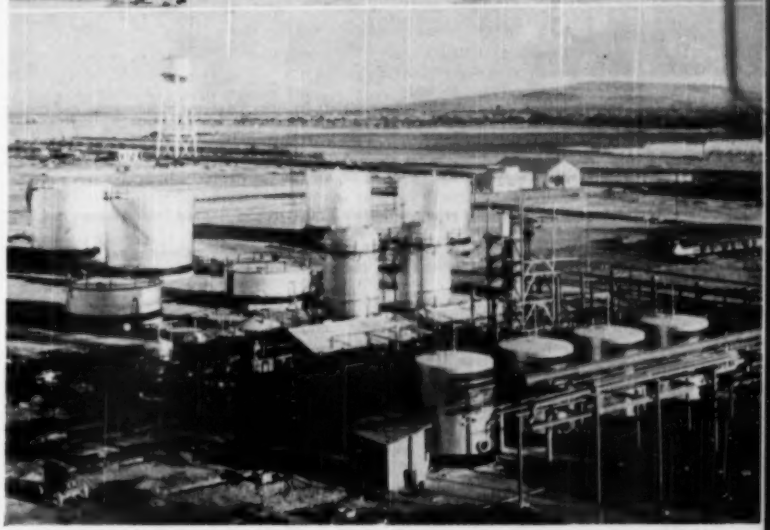
"Even so, we have come a long way from the historical imbalance created when all refineries built during the early period of Mexican oil development were concentrated on the coast to serve the export trade."

In 1944, Pemex increased the capacity of the Atzcapotzalco refinery by 24,000 barrels per working day.

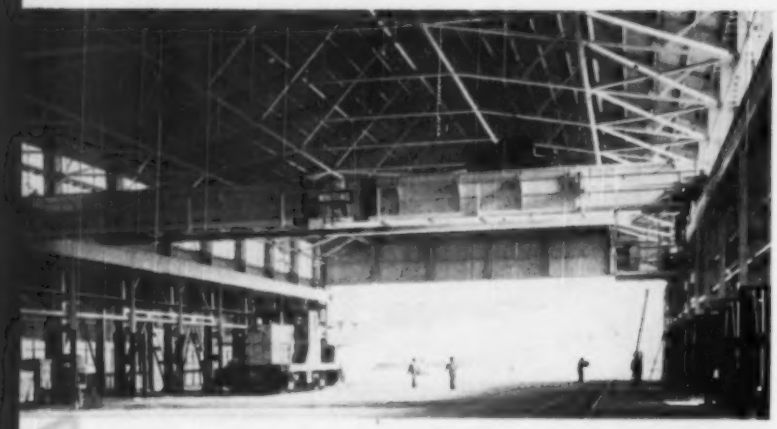
As a public service institution, Pemex must distribute, and make available at low price at any place in Mexico where the demand is established, a high proportion of fuel oils and burning oils, the senator said.

The relative proportions of products distributed percentagewise are fuel oils, 62; gasolines, 25; kerosines, 7.7; and gasoils, 5.3 percent.

Of the 66,700 barrels per day of fuel oils distributed, about 34,300 barrels per day are delivered to the railroads and the remainder to other industries. Since Pemex has to move a very low-priced commodity and distribute it widely, every efficiency in distribution is sought, Bermudez said. The Salamanca refinery will make the delivery of railroad fuel



Miscellaneous treating units (see photo at right) include 1) regenerative caustic treating units for mercaptan extraction from straight-run naphtha and cracked gasoline, 2) doctor treating equipment for kerosine with regenerative facilities for the doctor solution, 3) regenerative hydrogen sulphide removal unit (triethanolamine) for the liquefied petroleum gas, 4) tetraethyl lead blending facilities for the finished straight-run and cracked gasolines.



Tank car repair shop (top photo) includes complete facilities for repair, maintenance, and testing of railroad tank cars. In addition, there are separate small shops for sand-blasting and painting. Two diesel locomotives are provided for use in the plant.

Tankage and Accessories: The total atmospheric tankage is approximately 1,200,000 barrels capacity, distributed roughly as follows: crude oil, 450,000 barrels; fuel oils, 370,000 barrels; other products, 380,000 barrels.

The pressure storage consists of approximately 3000 barrels of finished liquid propane and 2000 barrels of finished liquid butanes.

The storage system is complete with transfer pumps, interconnecting piping, and loading racks to accommodate a total of 90 railroad tank car spots (lower photo).

oil right at the center of consumption, whereas formerly much of it had to be shipped from Tampico.

Consumption of petroleum products has increased more than 200 percent since 1937—a rate two and a half times that of the increase in U. S. requirements for the same period. And since Salamanca is situated in the heart of the area of expanding industrial and agricultural activity and has excellent rail and highway facilities in all directions, the refinery will ease the strains on transport facilities and will help sustain the high level of industrial output.

Salamanca is 180 miles northwest of Mexico City in the state of Guanajuato. The topographical route followed by the 280-mile, 12-inch pipeline from the Poza Rica field, which is directly west near the Gulf coast, further illustrates the geographical hurdles involved.

The pipeline has been built by Pemex. Nearly all the work at the refinery has been handled by Arthur G. McKee and Company, Cleveland. General buildings, roads, fences, some of the tankage, and the development of a 910-acre strip for a modern community, new industries and small farms have been carried out by Pemex.

Basic process and engineering information for the project have been furnished by Universal Oil Products Company, Chicago; the Girdler Corporation, Louisville, and Phillips Petroleum Company, Bartlesville.

Requirements for United States materials and services amounted to $15.5 million, and more than 400 U. S. firms have participated.

Accompanying photos show in some detail the major process units and auxiliary equipment.

The water system includes this storage tank (photo below) in addition to pumps, piping, cooling tower cells, treating equipment and other facilities for the cooling water and wash water supply to all process units and shops.

The steam plant has a separate cooling water system, including cooling tower, for the 3000-kw condensing turbo generator. Fresh water make-up is obtained from deep wells on the site.

United States Patent Office, Washington, D. C.

MANY misconceptions exist among technical people and executives in nearly every industry regarding the nature of the patent grant and the manner in which inventions should be protected. An understanding of our patent system and the nature of the patent grant by technical personnel and executives in our industries will go a long way toward the elimination of such misunderstandings.

In this first section of a two-part series, the authors explain the nature of the patent grant issue by the Patent Office of our government, discuss tests by which patentability can be judged, and the regulations which control the granting of patents. The second section, which will be published in an early issue, will treat the actual procedures followed in obtaining patents.

Inventions and Patents

Part I

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Gulf Oil Corporation, Washington, D. C.

IT IS difficult to escape the fact that the incentive given our inventors by the protection offered by the grant of a patent has been one of the major factors in our industrial growth. Strangely enough relatively few writers have given our patent system much credit for this industrial growth. It would seem appropriate here to remember that Lincoln once said, "The patent system added the fuel of interest to the fire of genius." The framers of our constitution had the wisdom to incorporate therein a provision for the present patent system. Article I, Section 8 reads as follows:

> "The Congress shall have power . . . to promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries."

As will be detailed, the grant of a patent makes public each step forward in every field of invention, and while it denies for a limited period the use of an invention so patented to the public without the consent of the patent owner, the patent gives the details of the invention to the public and to other inventors and thus spurs others on to make new developments and improvements in the field of inventive endeavor.

A patent is a contract between the public, as represented by our government, and the inventor for a period of 17 years. One of the requisites of a true contract is that there must be a consideration (something of value) given by each of the parties to the contract to the other party; and in the case of the patent grant, the consideration which the government gives the grantee is the right to exclude others from making, using or vending his invention for a period of 17 years, and the consideration given by the inventor to the public is the full, clear and concise disclosure of the method of practicing his invention.

A widely held belief is that the patent grant confers the *right* to make, use or sell an invention; nothing could be further from the truth. It must always be remembered that the patent grant confers only the right to *exclude others* from making, using or selling the patented invention. At first glance, it seems that this is merely a backhanded way of saying the same thing, but it will be seen that if a patented invention is an improvement on some earlier patented discovery, the practice of the invention covered by the later patent may actually infringe the earlier or basic patent.

For example, suppose Jones discovers that addition of compound A to a lubricating oil gives the oil good heavy-duty qualities if added in the quantity of, say, 1 percent. Jones obtains a patent covering this discovery. Later, Smith conducts research along the same line, and discovers that the heavy-duty agent used by Jones has a defect in that it becomes corrosive with continued use. Smith further discovers that the addition of 0.1 percent of compound Z effectively inhibits this corrosion, and obtains a patent covering his discovery. If Smith now attemps to make, use or sell the oil with

compounds A and Z in quantities of 1.0 percent and 0.1 percent, respectively, he will infringe Jones' patent since Jones claimed in his patent the mineral oil with the addition of 1.0 percent of compound A, and therefore, Smith would be making, using or selling the oil covered by Jones' patent. Situations of this kind are often taken care of by cross licensing agreements by means of which Smith and Jones each agrees to let the other use his invention.

When a patent is issued by the Patent Office, it is presumed to be valid; however, it must be remembered that the federal courts can invalidate a patent, and that many patents have been invalidated after bitter legal contests which were carried to the Supreme Court. The various grounds upon which patents are declared invalid will be discussed later.

Under the power given Congress by the constitution to enact laws covering the granting of patents, a number of statutes have been enacted. The principal statute with which this article is concerned is in part as follows:

> "Any person who has invented or discovered any new and useful art, machine, manufacture, or composition of matter, or any new and useful improvements thereof, . . . not known or used by others in this country, before his invention or discovery thereof, and not patented or described in any printed publication in this or any foreign country, before his invention or discovery thereof or more than one year prior to his application, and not in public use or on sale in this country for more than one year prior to his application, unless the same is proved to have been abandoned, may, upon payment of the fee required by law, and other due proceeding had, obtain a patent therefor."

Upon reading this statute for the first time it may seem wordy and difficult to follow; however, in the rest of this article most of the clauses in the above quotation will be taken up individually and their meaning discussed.

It will be noted that the statute states that "Any person . . . may . . . obtain a patent . . ." Thus a minor or a felon in a penitentiary or a person who is a citizen of another country may obtain United States patents. The only persons who are denied patents are employes of the United States Patent Office such as patent examiners during the period of their employment.

Only certain classes of inventions may be patented. Thus, from the statute quoted in part above it is seen that it is possible to patent, provided all of the other requirements for patentability are met, any new and useful:

1) Art—this is synonymous with "method" or "process." For example, a method of manufacturing a chemical or a process for catalytic cracking would come under this classification. This does not include a mental process or one dependent upon human reasoning ability.

2) Machine—this term embraces machines as commonly understood and various mechanical elements and combinations. The term "apparatus" is well applied to the items in this category.

3) Manufacture—there is no good definition for the items under this classification, but it is sometimes defined as "whatever is made by the art or industry of man, not being a machine, a composition of matter, or a design." For example, building structures, such as a particular type of roof structure have been held to be manufactures.

4) Compositions of Matter—this classification covers all compositions of two or more substances regardless of whether the result of chemical or mechanical union. This class includes chemical compounds.

5) Improvements—applies to all of the above classes.

The patent statutes also cover plant and design patents, but these two classifications will not be covered in this article.

If an invention is made which does not come under one of the classifications listed above, it makes no difference how valuable the invention may be, it is not patentable. A celebrated case illustrating this point is that of Dr. William Morton, the discoverer of the use of anaesthetic ether. Dr. Morton obtained a patent for his discovery of the use of anaesthetic ether and attempted to enforce it in court; the court held that Dr. Morton's patent was invalid because it was not covered by any existing provisions of the law.

Turning again to the statute, it will be noted that to be patentable an invention must be "not known or used by others in this country, before his invention or discovery thereof." Another way of saying this is that the inventor must be the "original and first" inventor or that the invention must be "new" or "novel." If it is found that an invention has been used before by others *in this country*, even though the use may be by a single person, the invention is not "new" or "novel" and if this is known by the inventor, he cannot make the required oath that he is the "original and first" inventor.

The statute next states that, in order to be patentable, an invention must be "not patented or described in any printed publication in this or any foreign country, before his invention or discovery thereof, or more than one year prior to his application" for a patent. Thus it is not possible to obtain a patent for an invention which has been described in a printed publication or patented in this or any foreign country either before the date of the invention or more than one year prior to the filing of the United States application for a patent; *but* if this printed description occurs less than one year prior to the filing of the application it is *possible* to obtain a United States patent. This can be done by showing that the inventor completed his invention prior to the date of publication of the printed matter which describes it. Steps necessary to establish this "date of invention" will be discussed later.

An inventor thus may be prevented from obtaining a patent by prior printed publications (and patents) by other inventors, also by such publications and articles by *himself*. It often happens that an inventor will write an article for a technical journal and then will find that in his article he has disclosed patentable subject matter. If more than a year elapses between the publication of the article and the date of his application for a patent, it is impossible for him to obtain a patent and his invention then becomes the property of the public or is said to pass into the "public domain." Many inventions have been rendered unpatentable in this manner, and all technical people should proceed cautiously in the handling of such articles, and obtain competent patent counsel if there is any reason to believe that patentable subject matter is present.

A further qualification in the statute is that the invention must not have been "in public use or on sale in this country for more than one year prior to his application." From this it is seen that the inventor must not publicly use his invention (other than experimentally) or sell it or allow others to use or sell it with his permission for more than one year prior to the filing of his application. Experimental use, in good faith, in order to perfect an invention is not public use even though it is continued for a number of years and is known to many people.

". . . unless the same is proved to have been abandoned . . ." is a still further qualification placed on the patentability of an invention. Abandonment occurs when an inventor dedicates his invention to the public, and may occur in various ways such as:

1) Actual abandonment—this occurs as the result of intention. An example would be a declaration by the inventor that his invention is open to the free use of the public.

2) Constructive abandonment—this occurs as the result of some statute which operates regardless of the intention of the inventor. An example of this would be failure to file a patent application within one year after the invention has been placed on sale.

Finally, returning to the first sentence of the statute, it will be noted that the thing or device to be patented must have been "invented or discovered." These two words, for the purpose of patent law, have identical meanings, and in further discussion only the word "invention" will be used. And what is an invention? Un-

United States Patent Office Research Room, Washington, D. C.

fortunately, it is difficult to give a cut and dried definition, but it is possible to study the terms the courts have used in deciding whether or not invention is present in various patents and it is also possible to give a number of positive and negative tests which tend to indicate the presence or absence of invention.

The United States Circuit Court of Appeals, Third Circuit, in Pyrene Manufacturing Company vs. Boyce, et al., (229 Fed. 480, 481) used the following definition:

". . . Invention is a concept; a thing evolved from the mind. It is not a revelation of something which exists and was unknown, but is the creation of something which did not exist before, possessing the elements of novelty and utility in kind and measure different and greater than what the art might expect from its skilled workers."

Therefore, we may assume that to rise to the dignity of invention, a device must show greater ingenuity than would be expected from the average engineer, chemist or technician who is skilled in the particular field or work or, as it is said in the patent practice "skilled in the art."

In the case Radiator Specialty Company vs. Buhot, (39 F. 2d 373, 376) the court said in part:

". . . Invention is not always the offspring of genius; more frequently it arises from accident or carelessness, occasionally it is a happy thought of an ordinary mind; and there have been instances where it is the result of sheer stupidity. It is with the inventive concept, the thing achieved, not with the manner of its achievement or the quality of the mind which gave it birth, that the patent law concerns itself."

It must be recognized that the test of whether or not invention is present is based on a shifting standard; for example, that which amounted to invention 30 years ago is now merely "skill in the art."

A would-be inventor or patentee is presumed to know the "prior art," that is, all of the patents and literature which are in the technical field of his invention; and if his invention is described in one of these publications, he is therefore presumed by law to have known of this prior invention.

In case of doubt, some of the positive tests which *may* indicate the presence of invention are as follows:

1) the invention satisfies a long felt want or need in the art;

2) the invention performs a step or process with greater economy or efficiency or is more useful than any prior step or process;

3) the invention is the result of long experimentation and/or is promptly adopted by the public;

4) or the invention succeeds where others seeking to achieve the same result have failed.

There are also certain tests which *tend* to indicate that invention is not present; some of these are as follows:

1) it is not invention to substitute one material for another; e.g. a superior material for an inferior material;

2) it is not invention to strengthen a machine, or make it larger or to make it portable;

3) it is not invention to reverse parts unless a new and unexpected result is achieved;

4) and it is not invention to substitute an equivalent for a part of a process, machine, manufacture or composition of matter unless the new part performs the old function and, in addition, another function.

To each of these positive and negative tests there are, of course, exceptions; these tests are only generalities and may not apply in any specific case.

It would hardly be proper to conclude this discussion of invention without a few comments on combinations and aggregations.

Inventions are said to be combinations and thus are patentable when the various parts of the invention assist and cooperate with each other to produce the desired result. It is not necessary that all of the parts act simultaneously, but the parts of the invention must be mutually dependent. A simple example of a combination is a wood plane; neither the body of the plane nor the blade alone could produce the same result as that produced by the combination.

A device is said to be an aggregation and thus is not patentable when there is no cooperation between the various parts or elements. An example of an aggregation is the ordinary pencil with an eraser on one end; there is obviously no cooperation be-

tween the eraser and the lead because the pencil will write and the eraser will erase in exactly the same manner as when used separately.

A patentable invention must consist of the following steps:

1) conception (conceiving the idea), and

2) reduction to practice.

Conception consists not in thinking or discovering that to achieve a certain result is desirable, but it consists of inventing a *method* of achieving the desired result. Long before Edison invented the electric light many people were aware that the invention of such a light was desirable, and it was the same with the telegraph, the telephone and countless other inventions. The patent laws, however, are not designed to reward those who merely realize that it is desirable to achieve a certain result, but are designed to reward those who conceive the *means* for achieving this result.

As stated before, the patent statutes provide that the inventor must be the "original and first inventor or discoverer of the art, machine, manufacture, composition, or improvement..." for which he seeks a patent and that he shall make oath to this effect. The inventor must also be the "true inventor" of the invention covered by the claims in the patent application which he signs. These points are extremely important as they may have a great effect on the validity of a patent after it has issued. If a patent becomes involved in court for example, in an infringement suit, if the alleged infringer can show that the inventor whose name appears on the patent is not the actual inventor of the invention covered by the claims, the patent then becomes invalid and the suit lost.

In research organizations and in other instances in which more than one person may work on an invention, it is of the greatest importance to ascertain whether the invention is the product of one inventor, called the "sole inventor" or whether it is the product of the joint efforts of two or more persons in which case the inventors are designated as "joint inventors." For example, if the director of a research group conceives a method of bringing about a certain result he is the "sole inventor" even though the invention is actually brought to a working condition and tested by others at his direction, provided that the exercise of inventive ability was not required to bring the invention to completion. On the other hand, if two or more persons work closely together each contributing to the invention, they are "joint inventors."

An invention should of course not be disclosed to outsiders or to the public during the period of its development unless the nature of the invention makes public experimentation necessary. However, once an invention has been conceived, the inventor or inventors should describe it in writing and make a sketch if possible and should date and sign the description and/or sketch. The invention should then be disclosed to others who can understand the nature of the invention, such as other technical workers or executives. The written, dated description of the invention should then be witnessed by the persons to whom it is disclosed who should sign the description and write the words "noted" or "read and understood" with the signature. It is undesirable to have a non-technical person who does not understand the invention sign the invention record.

The laboratory records of the conception of the invention and the steps in its reduction to practice should be kept in bound notebooks with each entry dated and *immediately* following the preceding entry. Permanent ink or indelible pencil should be used. No blank pages should be left between work entries, and the use of loose leaf notebooks should be avoided. Erasures must be avoided; mistakes should be corrected by striking through with a single line and indicating the correction. Paid bills and other evidences of experimental work should also be kept.

As stated above, an invention must consist of two steps; first, conception and second, reduction to practice. Reduction to practice may take place in two ways:

1) actual reduction to practice, which is developing the invention to a workable state, or,

2) constructive reduction to practice, which consists of filing a patent application covering the invention.

The most important thing to bear in mind regarding the development of an invention to the point of applying for a patent is the fact that, between the date of conception and reduction to practice, there must be reasonable diligence. This simply means that the inventor must keep working on his invention and attempting to improve it or to discover the limits of its usefulness. If an inventor does not show reasonable diligence, another inventor may conceive the identical invention at a later date, develop it with diligence and file a patent application. In this case, the second inventor will be awarded the patent regardless of the fact that the first inventor had an earlier date of conception. On the other hand, if the first inventor develops the invention with reasonable diligence, another inventor cannot obtain a patent on the identical invention even though the second inventor makes the first application in the Patent Office for a patent.

(End of Part I. Part II will appear in an early issue.)

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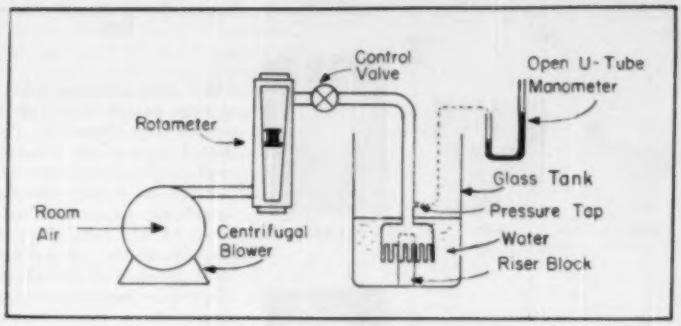


Figure 1. Flow Diagram of Test Apparatus.

Screen-Skirted Bubble Caps

FREDERICK A. ZENZ
Hydrocarbon Research, Inc., New York

DURING the past decade considerable effort has been directed toward the development of improved liquid-vapor contacting devices in the form of rotating columns, perforated plates, packing materials, spray towers and newer types of bubble tray designs. Such a variety of shapes of bubble caps and slot openings have also been made available that it becomes ever more desirable to make a visual study of the bubbling action of these various caps and the subject of tray hydraulics in general.

In order to investigate the performance of various cap designs a simple test program was initiated, designed to give qualitative, rather than quantitative, evidence of the relative operation. The flow diagram of the test apparatus is shown in Figure 1. All the reported tests were carried out with air and water as the vapor and liquid media. Room air was taken through a centrifugal blower and rotameter, and then entered the cap through a short pipe nipple welded to the top of the cap. In order to make the bubbling area conform more exactly to normal operation, a solid cylindrical block was centered under the cap to block off the volume normally occupied by the riser. Initial tests with a less versatile apparatus, consisting of a tray section, indicated identical bubbling action when air was permitted to enter through an actual riser. The use of a versatile glass tank arrangement as depicted in Figure 1 greatly facilitated the photographic work.

During the course of this investigation a completely new type of cap was developed which appears to give far better liquid-vapor contact. This cap is similar to the conventional round slotted bubble cap except that the slots are replaced by a nearly horizontal screen skirt. The principle and operation of this screen skirted cap may be illustrated by a comparison of Figures 2 and 3. Figures 2-a and 2-b depict schematically the operation of a conventional slotted cap at low vapor rates (slots about one-fourth open) and high vapor rates (slots fully open) respectively. The liquid-vapor contact which takes place in the liquid on the tray proper occurs within the volume V, which is defined as the mass volume of gas and liquid which is capable of interacting. It would therefore obviously be desirable to design a cap which would increase V, thus increasing separation performance, especially if this can be done with a minimum expenditure of energy (pressure loss or reboiler duty) while at the same time increasing tray stability. Figure 3 depicts the flow pattern of a properly designed screen-skirted cap. Note that this cap thrusts the formerly parabolicly depressed liquid-vapor interface into the body of the liquid on the tray, thus considerably increasing V, and decreasing the parabolic depression loss $\Delta h'$, a part of the head loss, Δh required to force the gas through the screen or slots. This reduction in $\Delta h'$ accounts for lower pressure losses in the screen skirt cap at high vapor rates. Obviously the mesh size of the screen must be properly chosen.

It should be pointed out here that the screen-skirted bubble cap was originally designed only for clean stocks and high liquid to vapor ratios where conventional caps are difficult to apply because the small gas quantities require the use of only a small number of caps.

In towers operating under heavy liquid loads with low-vapor rates the following is true: 1) the downspout area must be made large, and 2) since the quantity of vapor is small the number of bubble caps must be low in direct proportion to the volume of

THE screen-skirted bubble cap is a simple modification of the conventional type slotted cap. Relative pressure drop measurements and photographs of air-water tests with several caps are presented by the author to illustrate bubble cap flow characteristics. These tests indicate possible improved operating performance. By visual observation it appears to give better liquid-vapor contact in addition to somewhat lower pressure drop at high vapor rates.

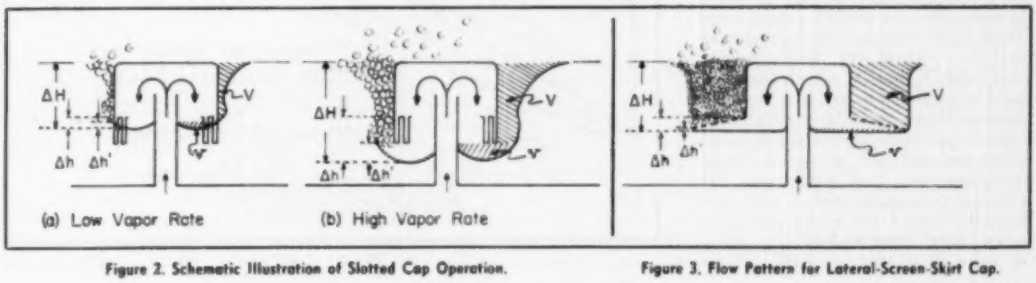


Figure 2. Schematic Illustration of Slotted Cap Operation.

Figure 3. Flow Pattern for Lateral-Screen-Skirt Cap.

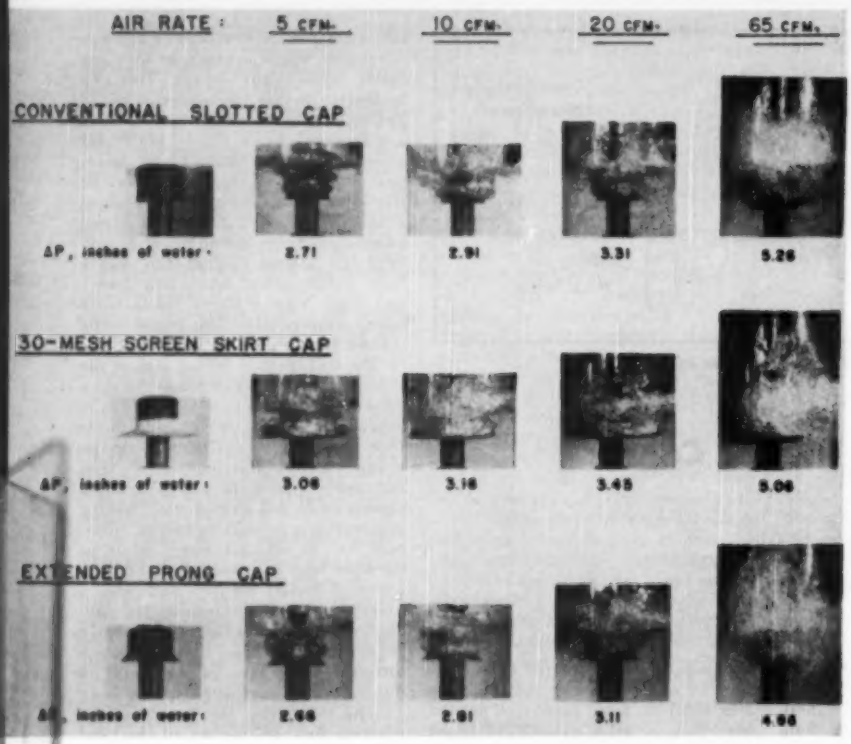

AIR RATE : 5 CFM. 10 CFM. 20 CFM. 65 CFM.
CONVENTIONAL SLOTTED CAP
ΔP, inches of water: 2.71 2.91 3.31 5.26
30-MESH SCREEN SKIRT CAP
ΔP, inches of water: 3.06 3.16 3.45 5.06
EXTENDED PRONG CAP
2.66 2.81 3.11 4.66

Figure 4. Photographs of Air-Water Tests.

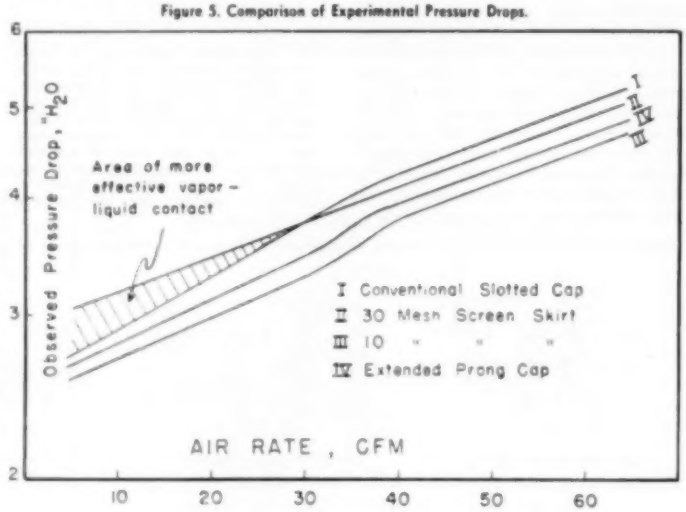
gas, causing the cap field to be a rather narrow bank. When the liquid flows across a narrow plate the resulting tray efficiency is lower than if the same liquid had flowed over a wider plate, provided that the degree of bubbling on each plate is the same. Since the screen cap at the same gas volume per cap extends its bubbling action over a much greater area than a standard bubble cap, an equal number of screen caps will occupy a greater tray area than standard caps, thus lengthening the flow path and increasing the tray efficiency.

Figure 4 presents a comparison of the recorded pressure drops and photographs of the bubbling action of three, 3-inch i.d. caps, tested at air rates of 5 to 65 cfm. per cap. The conventional slotted cap was provided with 34 equally spaced slots $\frac{3}{4}$-inch x $\frac{1}{8}$-inch. The extended prong cap, which many expected might operate as well as a skirted cap, also consisted of 34 slots $\frac{3}{4}$-inch x $\frac{1}{8}$-inch bent outward at an angle of 45°. The recorded pressure drops are only relatively significant inasmuch as riser and reversal losses are not fully accounted for in the arrangement used in these tests. All pressure drop measurements and photographs were taken under operation at an initial static seal of $2\frac{1}{4}$ inches of water above the top of the slots or uppermost edge of the screen.

The type of flow pattern shown in Figures 2-a and 2-b is represented in the photographs of the slotted cap operation at 10 cfm. and 65 cfm., respectively. The pattern depicted in Figure 3 is obviously represented in the photographs of the 30-mesh screen skirt cap. Experiments with a 10-mesh screen skirt gave indications of even poorer vapor-liquid contact than shown by the slotted caps. The proper mesh size is governed by surface tension, relative density liquid to vapor and viscosity of the liquid. It was also noted that the surface characteristics of the screen affected the degree of vapor dispersion; a rough screen favored steadier flow of gas through the wires into the liquid, the air was apparently reluctant to flow through highly polished screens.

The 30-mesh screen skirt cap appears in all cases to give better liquid-vapor contact within the body of the liquid and within the thicker layer of "froth" on the surface. Operation over the entire range of air rates was remarkably "smoother" than in the slotted caps. This may possibly bear explanation. When the throughput per cap is less than a certain volume, the cap surges or back traps and in general operates in an unsatisfactory manner. Thus, consider the conventional slotted cap shown in Figure 4. At 5 cfm. the air bubbled through partly opened slots; the ΔP was 2.71 inches of water; a difference of $2.71 - 2.25 = 0.46$-inch of water was exerted by the gas to open the slots. If a wave $\frac{1}{2}$-inch high passed over the

Figure 5. Comparison of Experimental Pressure Drops.



cap it would momentarily stop bubbling or in other words it would surge. The total area of vapor-liquid contact for such a small throughput is extremely small as can readily be seen in Figure 4. The screen skirted bubble cap, on the other hand, has a higher pressure loss at these low vapor rates, thereby minimizing the surging tendencies, and at the same time distributes the vapor over a wider area, affording better contact. At 5 cfm. the critical ΔP would now change from 0.46-inch to $3.06 - 2.25 = 0.81$-inch of water and in addition the caps could be spread more widely without loss in efficiency.

At air rates of 5 to 30 cfm. the 30-mesh screen incurs greater losses, while at rates above 30 cfm. the pressure losses are less than in the conventional slotted cap. Figure 5 is a plot of the observed pressure drops. In a conventional bubble cap the pressure drop can be broken down into two main components, the static head above the slots and a depression in the main body of the liquid as the gas forces its path through the slots. An examination of Figure 4 shows that for low throughputs the equivalent liquid-vapor contact volume (described in Figure 2-a) is small per unit of gas pumped through the cap, for example, at 5 cfm. the Δh is equal to 0.46-inch of water, and the V is very small as seen in the photograph. On the other hand, the screen skirted cap at the same throughput has a higher Δh which is converted into a much larger V and also permits smoother operation, as described above.

It can be concluded that at low flow rates the effective liquid-vapor interacting volume is much greater, in proportion to Δh for the screen cap than for a slotted cap. This is illustrated schematically by the shaded area in Figure 5. At high vapor rates a properly designed screen cap will give equally effective, if not better, contact than the conventional slotted cap and even at a lower pressure loss, as shown in Figure 5 and the comparison of the 65 cfm. photographs in Figure 4. The extended prong type cap appears to give nearly as good contact as the simple slotted cap and operates at lower pressure drops since the liquid need not be depressed as far to give the equivalent slot opening.

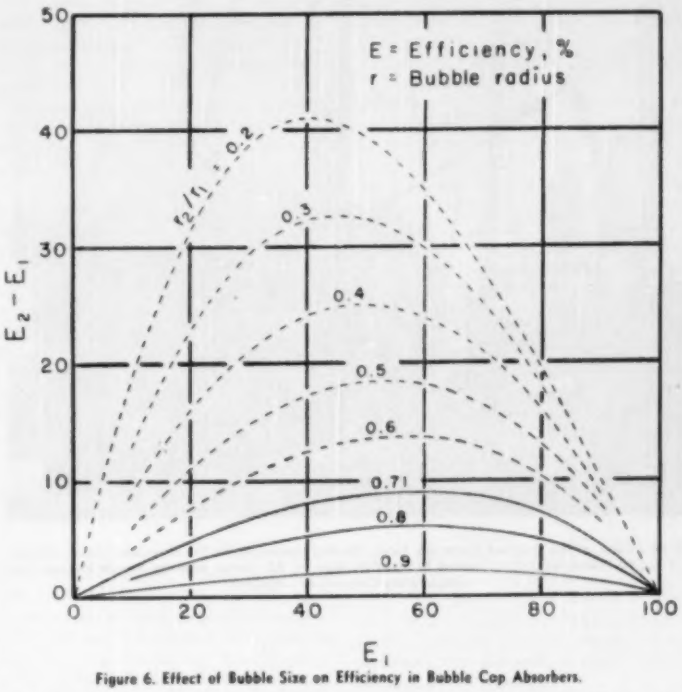
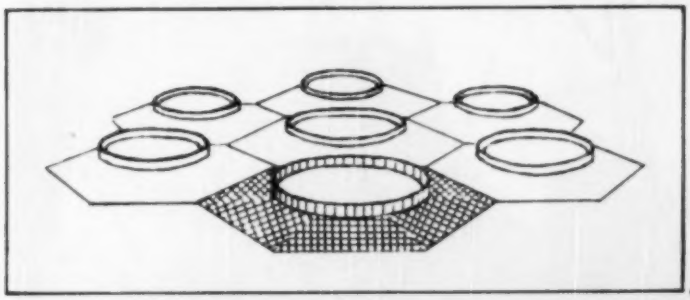


Figure 6. Effect of Bubble Size on Efficiency in Bubble Cap Absorbers.

A rough quantitative estimate of the possible increase in efficiency to be anticipated with screen skirt caps may be made from a correlation of gas-film controlling absorption experiments in conventional bubble cap towers recently reported by Etherington.[1] Figure 6 is based on this correlation and indicates the effect of bubble radius on Murphree plate efficiency. The solid curves indicate the experimental range of bubble radii reported and the dashed curves indicate the effect that may be calculated over the entire range of Etherington's correlation. From enlarged photographs it was estimated that the bubble radius for a screen skirt cap is at least 30 percent smaller than the equivalent radius of a bubble formed at a slotted cap. The minimum increase in efficiency, $E_2 - E_1$, to be expected when changing from conventional slotted caps operating at efficiency E_1 may be estimated from Figure 6 along a curve of r_2/r_1, equal to 0.7.

The principle of this type of screen skirted cap lends itself very simply to application over an entire tray; caps without slots may be mounted in the usual manner and the entire area between caps given screen coverage by perforating a large sheet of screen to accommodate the cap arrangement, then slipping this sheet down over the caps already mounted on the tray. At the time the cap holes are punched in the screen it may also be crimped to give the proper angle of inclination about each cap. Figure 7 is a schematic isometric of a portion of a screen sheet of this proposed type of one piece construction for full tray coverage on triangular cap spacing. The screen sheet may be spot welded to the tray at several points or possibly otherwise fastened to a few of the caps.

Figure 7. Schematic Isometric of Screen-Skirt Sheet.



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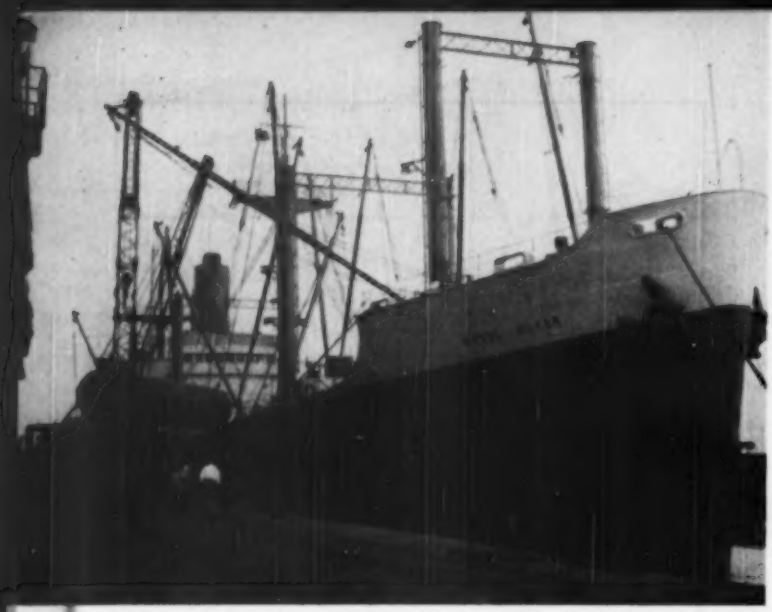


Steel Maker, of the Isthmian Steamship Lines, loading equipment for the Hawaiian Islands refinery of Pacific Refineries, Ltd. It docked in Honolulu May 14. All photos courtesy Arnold Hegwer, Fish Engineering Corporation, engineer.

"Packaged" Butane-Asphalt Refinery Arrives at Honolulu Site

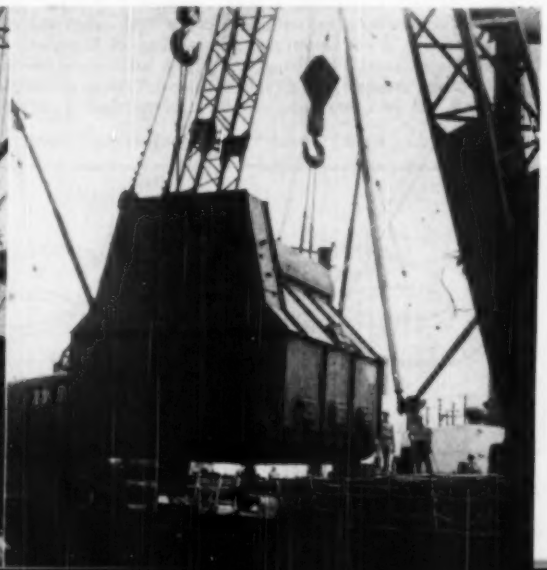
THE main objective of the Honolulu refinery installation for Pacific Refiners, Ltd., is to transport butane to the Islands from the mainland as a bulk shipment for use as LPG fuel to serve the population of the Islands not now being served by manufactured gas from the plant of Honolulu Gas Company; in addition, to supply Honolulu Gas Company with a better grade of oil for making manufactured gas to improve the service to its customers.

Butane is now being transported to the Islands as a package shipment in cylinders, the cost of which prohibits its extensive use of a fuel. Likewise, the cost of importing to the Islands a refined product for gas plant charge stock would be prohibitive on account of the initial cost of the refined product and the higher transportation rate.

The estimated total population of the Hawaiian Islands as of 1948 was approximately 540,500, of which Honolulu had 277,129. The gas company in December, 1948 had 36,556 meters or one to every 7.6 persons. The average general service and refrigeration customer used 55,247 cubic feet yearly which is equal to 268 gallons of butane. The population of Hawaiian Islands outside of Honolulu is 263,000 and with the exception of Hilo's 29,620 population is not now served by gas. The price factor has limited distribution of LPG to this quarter of a million people. It is understood that the manufactured gas plant in the city of Hilo is to be discontinued and its

Below, left—Loading the debutanizer tower, 92 feet long, 42 inches diameter, and weighing 40,000 pounds on the deck. Heat exchangers, accumulators, small process vessels, pipe, valves, fittings, instruments, ladders, platforms, and other equipment had been loaded into the ship's hold.

Below, right—Cranes lifting one of the two boilers weighing 64,000 pounds each. To obtain proper weight distribution, the boilers, shipped to Houston from Michigan, were loaded one on each side near the center of the ship.



THE FIRST OIL refinery in the Hawaiian Islands is under construction in the harbor district of Honolulu. Costing approximately $1,500,000, the new plant is designed for 1,080,000 barrels per year of special charging stock, from which it will produce 2,721,000 gallons of butane, 508,000 barrels of gasoil, and 90,000 tons of asphalt. Butane, previously shipped to the Islands in pressure cylinders, will be dissolved in a mixture of heavy oils and shipped in standard tankers from California as charge to the plant. Thus, the products the refinery will produce are transported economically in bulk shipments to the Islands.

As a result of the refinery, gasoil, a more efficient fuel for manufactured gas, will be used in the Honolulu manufactured gas plant instead of heavy residual oil. In addition, butane from the refinery will be distributed to the outlying areas not served by city gas. The asphalt will serve for Island road building, for roofing construction, etc.

One of the most interesting phases of construction of the refinery for Pacific Refiners, Ltd. by Fish Engineering Corporation of Houston, was that of supplying the equipment to the site. Approximately 90 percent of the heavy equipment—boilers, towers, storage tanks, and heat exchangers —and accessory equipment—instruments, valves, pipe and fittings—were specified and ordered shipped from the manufacturers to Houston, designated the equipment grouping center. When this equipment had been received, it was loaded aboard ship and transported to the plant site—a "one-ship load."

Ray C. Fish, president of Fish Engineering, provided the accompanying discussion. Completion of the refinery is expected late this summer.

customers will be supplied with butane from the new refinery.

On the basis of 7.6 persons per meter, it can be assumed that the potential market for liquefied petroleum gas ot the balance of the population of 263,000 not now being served with gas equals a potential market for liquefied petroleum gas of 9,260,000 gallons per year. The ultimate market on the basis of 5 persons per installation would equal an ultimate potential market of 14 million gallons per year.

Under the refinery type of operation, it is estimated that butane can be distributed to the various customers at a price equal to the present delivered cost to the Islands, which will make the butane competitive, or less than other types of fuels, and thus make for the wide use of butane. On the basis of transporting butane as a bulk shipment to the Islands and thus making it available to the consumers at approximately half the present retail price, it is believed a minimum market of approximately 5 million gallons per year is available to the operation.

The oil charge stock requirements of Honolulu Gas Company for manufactured gas purposes average approximately 400,000 barrels of oil per year. Bunker "C" fuel oil is now being used for this purpose. The oil, a heavy asphalt base oil from California, results in a considerable amount of gum, tar and sulphur deposits in the gas distribution system. It is believed that the efficiency of the manufactured gas operations can be improved as much as 20 per cent, by using heavy gasoil as a fuel. Resulting improvement in quality of gas and service will make for the greater use of gas by present and new customers.

This basic oil requirement for the gas plant will be used as the "carrier" for transporting the butane to the Islands in bulk, the butane being dissolved into this material.

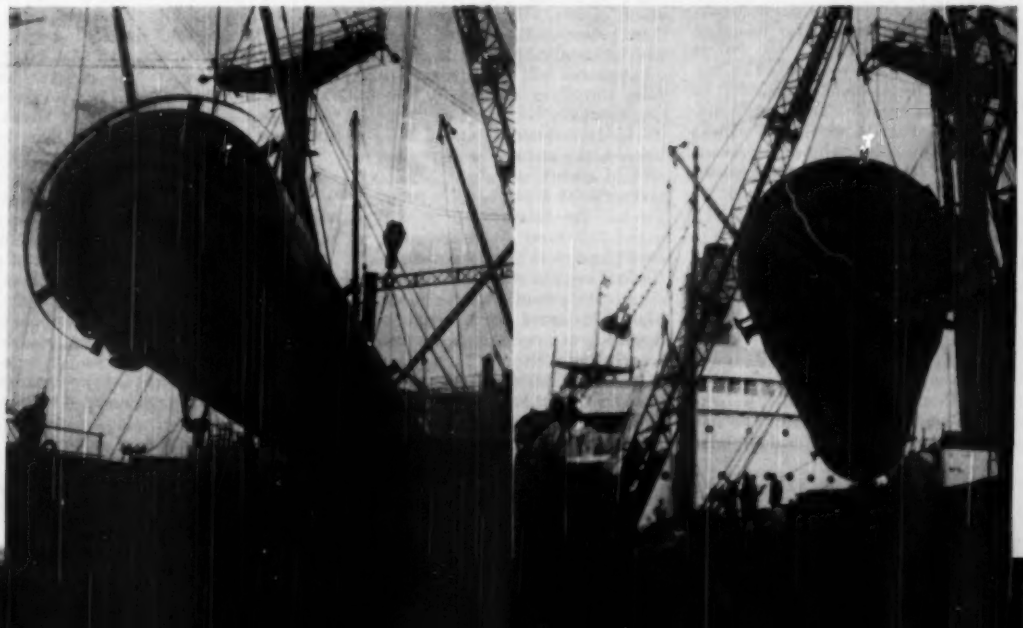
In addition to the fuel requirements for the gas plant, asphalt is being transported to the Islands as a package shipment in drums. Present yearly consumption of asphalt approximates 50,000 tons (290,000 barrels) per year.

The oil charging stock suitable for supplying the basic fuel requirements of the Honolulu gas plant and the asphalt requirements of the Islands is California heavy asphalt base crude or reduced crude from a refinery. Laboratory experiments have shown 6 per cent butane could be dissolved into such oil and the mixture transported in standard type oil tankers and handled without undue losses.

Present oil charge stock requirements for the gas plant and the present market for asphalt equal 690,000 barrels per year, an amount of "carrier" stock that will transport approximately 40,000 barrels (1,680,000 gallons) per year of butane.

In addition to these amounts of oil required, there will also be required an additional volume of gasoil for cutback stock with asphalt to produce

Another view (below, left) during loading of the debutanizer tower. The asphalt vacuum tower loaded on the opposite side of the deck is 102 inches in diameter, 70 feet long, and weighed 98,000 pounds. Below, right—Loading one of the butane storage tanks, shipped from Louisiana to Houston.



road oil. So it appears that present "carrier" stock will care for a minimum butane dissolved in the "carrier" oil of from 1,680,000 to 2,000,000 gallons per year.

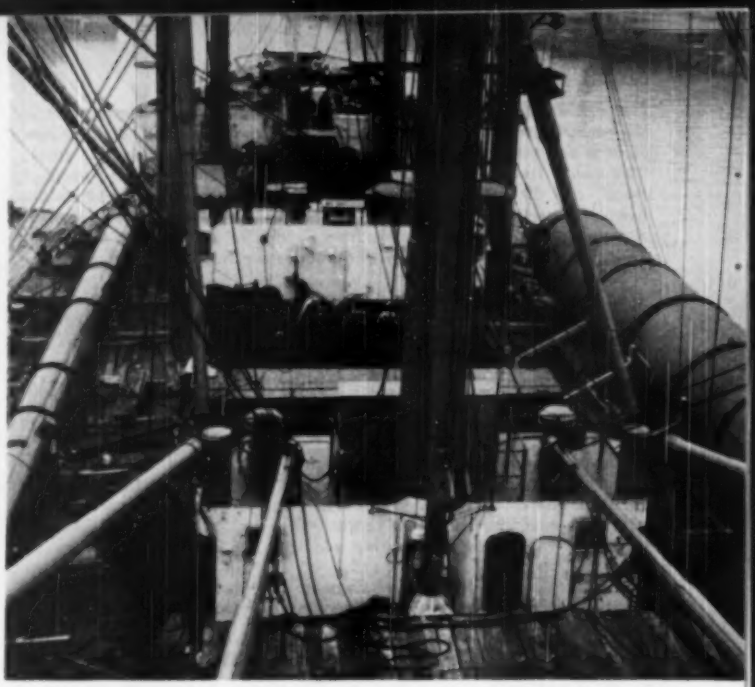
Oil requirements for the gas plant likely will increase and this increase in demand of "carrier" stock will, of course, permit transporting more butane to the Islands to meet the developed market for butane. Should the market for butane develop beyond the "carrier" capacity, then fuel oil as required by other industrial users can also be used as "carrier" stock, which would produce from the present refinery unit approximately 2,700,000 gallons per year of butane.

The refining installation is designed to process 3000 barrels per day of oil charging stock of the general specifications contracted for with Standard Oil Company of California. The process design of the plant incorporates standard and proven processes and consists primarily of two units, one for the distillation of butane from the oil charge stock, purification and dehydration of the butane for market, and the other for the vacuum distillation of the reduced crude into gasoil and specification asphalt.

The butane will be removed as an overhead product from a pressure butane stripper fractionating tower, condensed as a liquid, treated for sulphur and dehydrated. The butane stripper will be equipped with a side-stream stripper for fractionating any naphtha contained in the charge stock, which will be blended with the gasoil made from the asphalt column.

The butane-free bottoms from the butane stripper will then pass through a heater where the temperature of the charging stock will be raised and will flow to the asphalt fractionating column operating under vacuum where gasoil will be removed as a side stream. The gasoil will be used for manufactured gas plant charge stock and as cut-back stock for road oil. The bottoms from the vacuum column will be specification asphalt. The asphalt column will also be equipped with a second side stream stripper for removing diesel oil if, as and when the charge stock contains such a cut.

The refinery will be complete with maximum heat exchange equipment to minimize the amount of fuel required for its operation. Instruments and controls will be used to make the plant as nearly automatic in operation as possible. The tankage for storage of charge stock will be of floating-roof design to hold weathering losses to the minimum. Pressure storage will be provided for storage of butane. The balance of the storage for asphalt, road oil, naphtha, gasoil, etc., will be of atmospheric type.



Forward deck of the Steel Maker. The debutanizer is at the left and the vacuum tower at the right. Two butane storage tanks, each having a capacity of 30,000 gallons and weighing 67,000 pounds, were also loaded on the ship.

Two water-tube boilers will furnish steam requirements of process and operation of certain pumps. Electricity will be purchased locally.

Fresh water requirements will be obtained from the city water supply, and the water required for the process cooling and condensing will be salt water circulated from the ocean.

Loading facilities will consist of a butane truck loading dock and an asphalt and road oil truck loading dock. Skid tanks and/or truck trailers for shipment of the finished products to other islands will also be loaded at these points. Butane bottling facilities will be installed at the plant. The gasoil produced will be transferred direct from the plant storage to Honolulu Gas Company by pipe line.

The normal charge stock to the refinery will consist of a mixture of gasoil and asphalt residuum containing a maximum of 6 per cent by volume of butane. The mixture of asphalt and gasoil will form a mixture not to exceed 53 per cent by volume of asphalt, with an average asphalt content over a six-months period of 50 per cent. The plant is designed for the maximum of flexibility of operation to meet market requirements. The market requirements of road oil will define the method of operation for the asphalt column as to the nature of the two gasoil cuts that will be made.

Operating at a charge stock rate of 3,000 barrels per day of average oil charge stock, the plant is estimated to produce 47,370 gallons of light gasoil, 11,850 gallons per day of heavy gasoil, and 250 tons of asphalt to storage per day, with the first column in the plant producing 7560 gallons per day of butane. Under other operating conditions, the second column will produce 20,750 gallons of light gasoil, 38,470 gallons of heavy gasoil, and 250 tons of asphalt per day, with the first column producing the same amount of butane of 7560 gallons per day.

It is also possible that at times the stock shipped will contain material lighter than gasoil and falling within the naphtha range. Under such conditions the butane stripper column is designed so that this naphtha cut can be removed and withdrawn as a side stream from the column so that the naphtha will not pass overhead and contaminate the butane.

The plant as designed is guaranteed to produce from the average feed stock the quantities and compositions as outlined, the asphalt produced being of a penetration range as desired between 60 and 100.

The yearly capacity of the refinery as designed is 1,080,000 barrels per year of charge stock of which 6 per cent can be butane, equal to 64,800 barrels (2,721,600 gallons) of butane; 508,000 barrels per year of gasoil; and 90,000 tons per year of asphalt.

Application of Polarography In the Petroleum Industry

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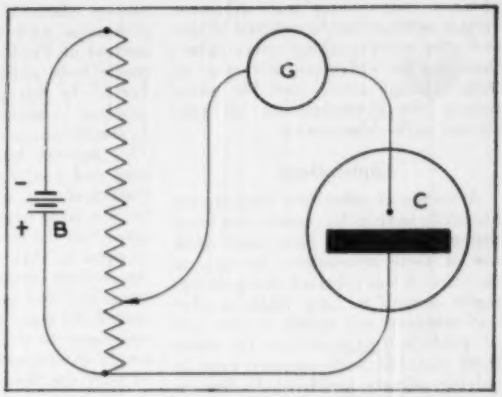


Figure 1. Scheme of Circuit Used for Polarographic Analyses

POLAROGRAPHIC methods of analysis consist essentially of the electrolysis of solutions of electroreducible or electrooxidizable substances, using a completely polarized electrode in conjunction with one that is not polarizable. The resulting current-voltage curve may be recorded. The curve obtained can be evaluated to determine the identities and respective concentrations of the reducible or oxidizable substances present. Inasmuch as a number of significant characteristics of polarography exist which make the method of special interest, and because many of the analytical problems in the petroleum industry are readily solved by applying these techniques, a general orientation concerning methods and applications seems warranted.

Both organic and inorganic substances can be determined by means of polarography although the method is not applicable in all cases. Those substances which are readily oxidized or reduced generally lend themselves to analysis and so provide a wide variety of applications. Particularly significant factors contributing to the use of polarographic methods are the sensitivity, which permits the analysis of solutions which are one hundredth to one millionth molar with respect to the substance to be determined; the accuracy, which is usually less than two percent error; the versatility, which permits analysis of a given sample where concentrations may vary over a thousandfold with no more modification of procedure than a twist of a shunt setting; and rapidity, which enables critical evaluation of prepared solutions to be completed within five minutes and with certain modifications of technique, individual determinations can even be completed in less than one minute.

A number of monographs and reviews are available which cover the principles, general instrumentation, and methods of polarography.[10,11,13,17] Of special interest are the current reviews of recent developments,[14,15] as well as the annual reviews on organic polarography.[21,22] An excellent survey of applications of polarography in organic analysis is also available,[26] and a comprehensive summary of the polarographic determination of carbonyl compounds has recently appeared.[19]

Instrumentation and Method

As mentioned previously, polarography involves an electrolysis of solutions in which a completely polarized electrode is used together with one that is not polarizable; the usual arrangement is to employ a dropping mercury pool or a calomel reference electrode. A source for applied e.m.f. (electromotive force) is provided by means of dry cells and a means of integration between selected potentials is obtained through the use of a slide wire. A sensitive galvanometer is used for current measurements and an Ayrton shunt is added to extend the sensitivity range. The essential instrumentation of a manual-type instrument is shown in Figure 1 and the schematic diagram of a photographically recording instrument is shown in Figure 2. Of special interest for industrial work are the strip chart recording instruments which are relatively unaffected by minor vibrations—an important characteristic for many laboratories. Examples of such instruments are the Visible Recording Polarograph (Model XXI), the Polaro-Analyzer, and the Electrochemograph.

The portable instrument recently described by Delahay[4] should be of interest for industrial work since it eliminates the necessity of using a delicate galvanometer. With such an instrument it will be possible to make on-the-spot checks and to move the instrument wherever and whenever necessary. The Elecdropode, a manually operated instrument suitable for moving to points of need, has proven to be a dependable and handy analytical tool.

The methods of polarography may vary considerably according to circumstance. The usual procedure employs previously prepared aqueous solutions of the substance or substances to be determined which are placed in electrolysis cells containing a mercury pool or which are in electrical contact with a saturated calomel electrode. The solution to be electrolyzed should contain a suitable supporting electrolyte and should ordinarily be free of oxygen, either through use of sulfite or by purging with nitrogen. The dropping mercury electrode is then inserted and a plot obtained of the change of current with increasing potential drop across the electrodes. By use of plots of diffusion current versus concentration, working curves can be

***NEW ANALYSIS** techniques have been developed which are especially suitable to the needs of refinery laboratories. The polarograph is useful for the determination of tetraethyl lead in gasolines, small amounts of inorganic additives in lubricating oils, sulfur in its various forms, the analysis of catalysts for major components, trace additives and impurities, and many others.*

The discussion originally was before the December, 1949, regional meeting of the American Chemical Society at Oklahoma City.

obtained; for control work arbitrary voltage settings can be selected before and after current-voltage curve inflections and the difference in current at these selected points used for establishing the concentrations of substances under observation.

Applications

A survey of petroleum laboratories known to have polarographs disclosed that most companies have made good use of their instruments. In one or two cases it was reported that polarography seemed to have little to offer and attention was called to the lack of published procedures in which these methods were actually used in solving refinery problems. In this regard it should be pointed out that because standard procedures of polarographic analyses are available for such a wide variety of determinations and because often only slight modifications are required to adapt such procedures to refinery problems, many laboratories have been reluctant to publish accounts of specific applications.

Some idea of the general importance of polarographic techniques to the petroleum industry can be obtained from the statement by Simpson[20] that in the Socony-Vacuum Laboratories one polarography is used for both service and development work, and to date 22 methods have been developed or adapted to specific problems. The service work completed in August, 1949, consisted of 577 determinations of which one-third were for organic materials and two-thirds were for metallic constituents.

The following summary of established uses of polarography is presented to serve as an orientation; in most cases the details of procedure are omitted since standard methods are applicable. The examples cited are by no means the only ones known but are representative of control and special analyses encountered in many refineries. Research problems can often be followed polarographically but it would extend the present discussion unreasonably to try to include such applications at this time.

Inorganic Applications. Probably the application of the polarograph that has aroused the most widespread interest throughout the petroleum industry has been the determination of *tetraethyl lead* in gasoline. In 1940 Frediani and Bass[5] described a polarographic method for analysis of the solution obtained by extraction of the gasoline with hydrochloric acid according to ASTM D526.[1] Their method reduced the time required for an analysis considerably as compared to the various chemical procedures. A simplification and refinement of the method of Frediani and Bass has recently been published by Borup and Levin.[2] In this procedure 10 ml. of gasoline is extracted with 10 ml. of hydrochloric acid on a steam bath. This aqueous layer is diluted to volume and analyzed polarographically. Statistical analysis of the data obtained from a large number of analyses indicated that the precision of the method is equal to that of chemical methods. An average deviation of 0.02 ml. of tetraethyl lead per gallon may be expected. As many as 35 analyses can be completed in one man day, and for a single determination an elapsed time of only one hour is required.

Numerous modifications in the details of the analysis have been devised by various petroleum laboratories, but as yet no method has been published that would eliminate the extraction step. Obviously, such an improvement would effect an additional saving in time for the analysis of gasoline.

Many modern lubricants contain small amounts of *inorganic additives* as oxidation inhibitors, detergents, etc. The polarograph is particularly well suited for the determination of these additives because of the small amounts involved and the absence of other interfering metals. Zinc, cadmium, copper, tin, antimony, chromium, barium and sodium are a few examples of additives that can be determined polarographically. Although the procedures vary depending upon the metal, its anion, and the nature of the oil, the metal is usually removed from the oil by acid extraction or dissolution of the ash in acid. The metal is then measured by conventional polarographic techniques.

The determination of *sulfur* in its various forms is one of the most troublesome analyses encountered in a petroleum laboratory, because of the many forms in which the sulfur is found, and the fact that it is frequently present in trace quantities. The poisoning action that even small amounts of sulfur have on some catalysts and its deleterious effects on product quality make the determination of sulfur an important problem.

A polarographic method for determination of elemental sulfur has been described by Proske.[15] He utilized a pyridine solvent with a mixture of acetic acid, sodium acetate, and tylose as supporting electrolyte. Although Proske applied the method to the analysis of rubber, it is presumably applicable to petroleum products.

A modification of the polarographic method in which a substance is determined titrimetrically and the polarograph is used to detect the endpoint has been used to determine mercaptans.[9] The sample is dissolved in ammoniacal alcohol and titrated with silver nitrate solution. The increase in diffusion current caused by the presence of excess silver ions signals the endpoint. As little as 0.2 mg. of mercaptan can be determined with an error of 1 or 2 percent. This amperometric procedure can also be used to determine disulfides.[8] The disulfides are reduced to mercaptans by treatment with zinc amalgam and the mercaptans titrated with silver nitrate.

A polarographic procedure has been found useful for the determination of very small amounts of hydrogen sulfide in hydrocarbon gases, in hydrogen, and in hydrogen-carbon monoxide mixtures (synthesis gas). A measured volume of gas is scrubbed through a standard dilute solution of cadmium acetate, with sodium acetate added as a supporting electrolyte. The decrease in concentration of cadmium, measured polarographically, is proportional to the amount of hydrogen sulfide absorbed. Amounts of hydrogen sulfide as small as 1 mg. per cubic meter of gas can be determined. By conversion of other sulfur compounds to hydrogen sulfide by passage of the gas over aluminua or platinum at 900° C.,[6] the total amount of sulfur in the gas can be measured.

The analysis of *catalysts* both for major constituents and for trace additives and impurities has become increasingly important in recent years because of the growth of catalytic refining processes. It would not be feasible to discuss in this paper all the many applications of polarography to this type of analysis, but two examples will serve to illustrate its usefulness.

More Rapid Procedure

Silica-alumina catalysts are thought to be adversely affected by relatively small amounts of sodium. The analysis of such materials for sodium by chemical methods is time-consuming. A more rapid polarographic procedure, which is also applicable to other types of catalysts, has been described by Weaver and Lykken.[23] The catalyst is dissolved in sulfuric and hydrofluoric acids, the solution evaporated to dryness, and the residue redissolved in water. An excess of tetraethyl ammonium hydroxide is added as supporting electrolyte, and the sodium measured polarographically. The accuracy is reported to be ±3 percent of the amount of sodium present and amounts less than 0.1 percent sodium can be determined.

Other trace elements, such as iron, lead, cadmium, and nickel, have also

been determined in silica-alumina catalysts.

Small amounts of nickel have a deleterious effect on the hydrocarbon synthesis reaction when the Fischer catalyst, cobalt-thoria-carrier, is used. The determination of small amounts of nickel in the presence of cobalt is a difficult analysis by chemical methods. A simple and rapid polarographic procedure has been devised for this analysis. The catalyst is dissolved in hydrochloric acid and pyridine added to provide a supporting electrolyte. The polarographic wave of nickel in this solution is well-defined even in the presence of a thousandfold excess of cobalt.[16]

Metal constituents of *feed stocks* have been determined polarographically, including such metals as vanadium, iron, copper and nickel.

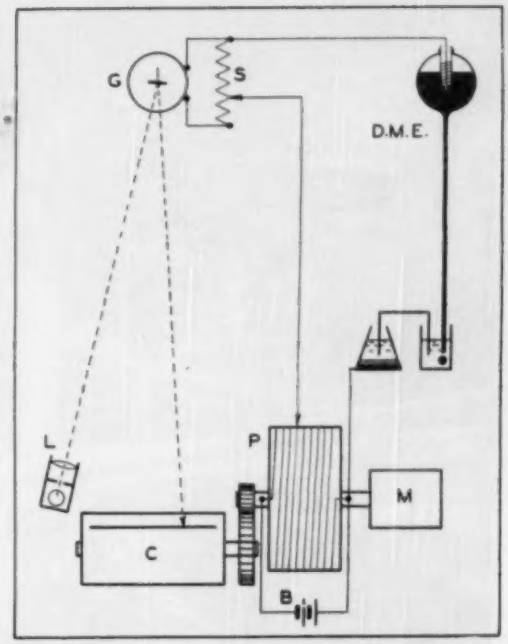
The *oxygen* content of water can be determined easily by the polarograph. In the petroleum industry this is useful for measuring oxygen in cooling waters in guarding against corrosion. Another application is to the determination of oxygen in waste streams where low oxygen content would endanger marine life. The oxygen content of gas can also be determined polarographically by absorbing the oxygen in a solvent and measuring the dissolved oxygen.

A large number of *miscellaneous* applications exist. For example, lead in Doctor solution and in air has been determined polarographically. Nickel has been determined in alcohol and various metals present in acids and other heavy chemicals have been determined at the dropping mercury electrode. Sulfates from hydrocarbon sulfonates have been estimated by amperometric titration.

Organic Applications. Although the potential applicability of polarography to the determination of organic substances in petroleum products is very great, the difficulty of selection of a suitable solvent has been a limitation. Since petroleum products are largely insoluble in water, nonaqueous solvents are required. This presents certain problems in technique, such as providing a supporting electrolyte, and removing all dissolved oxygen. However, a number of useful applications have been made and many more are undoubtedly possible.

The importance of naphthalene as a raw material for manufacture of phthalic anhydride necessitated a simple routine method for determination of naphthalenes in petroleum fractions. Burdett and Wood[2] described a polarographic method that gave the amount of naphthalene, acenaphthene, and β-methylnaphthalene in kerosine and light gasoil in 30 minutes of analysis time. The sample is weighed into a solvent consisting of 85 percent dioxane and 15 percent water and which is 0.1 M with tetra-n-butyl ammonium iodide as supporting electrolyte. A polarogram is made between —1.8 and —2.3 volts. The wave-height is proportional to the sum of naphthalene and its derivatives in the sample.

Figure 2. Diagram of Polarograph and Electrolytic Cell.



Other aromatic polynuclear hydrocarbons are also reducible at the dropping mercury electrode,[24] and could probably be determined polarographically.

The determination of *aldehydes* is of importance, and the routine estimation of acetaldehyde in alcohol is very well suited to polarographic techniques. Determination of acetaldehyde in complex mixtures of olefins and diolefins and in liquefied C_4 cuts of butadiene has been described by Elving and Rutner.[5] Saturated aliphatic ketones are not readily determined polarographically,[10] but derivatives obtained with Girard's reagent or phenylhydrazine can be reduced at the dropping mercury electrode. Aromatic ketones, α and β diketones and α, β-unsaturated ketones can be determined directly.

Various substituted acetylenes and olefins are reducible at the dropping mercury electrode,[12,22] and therefore could be determined polarographically. Such compounds include styrene, stilbene, and phenyl-substituted ethylenes. Isolated double or triple bonds are not reducible.

ACKNOWLEDGMENT

The authors wish to take this opportunity to acknowledge the assistance given by many individuals and companies who contributed to the preparation of this paper by describing applications of polarograph in use in their laboratories.

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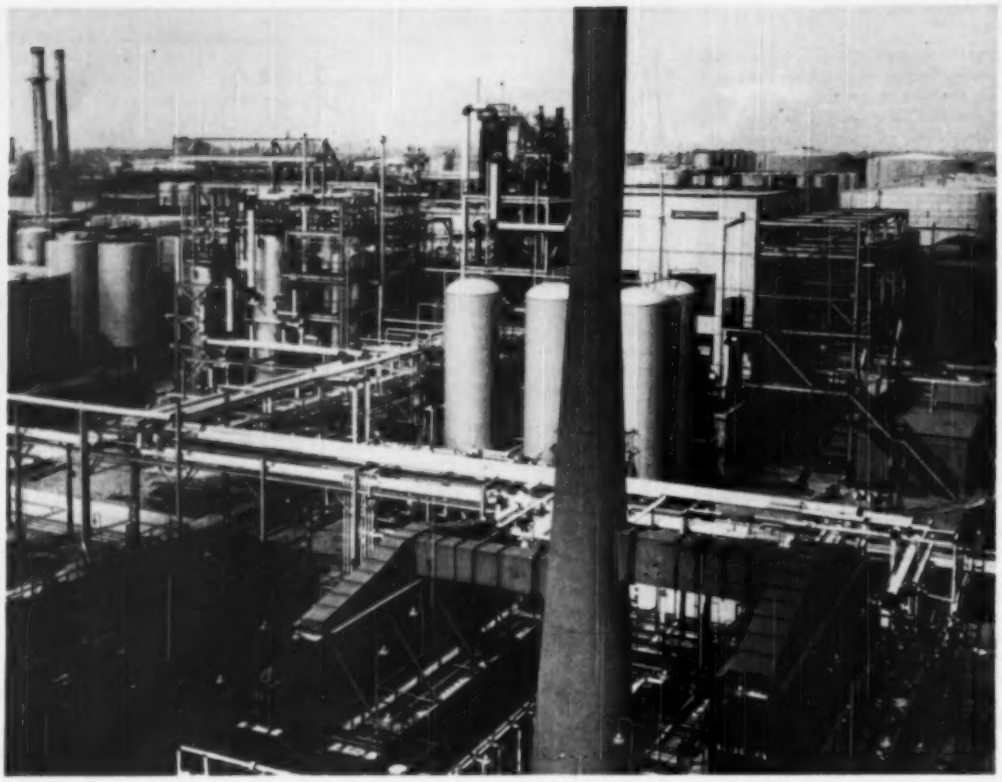
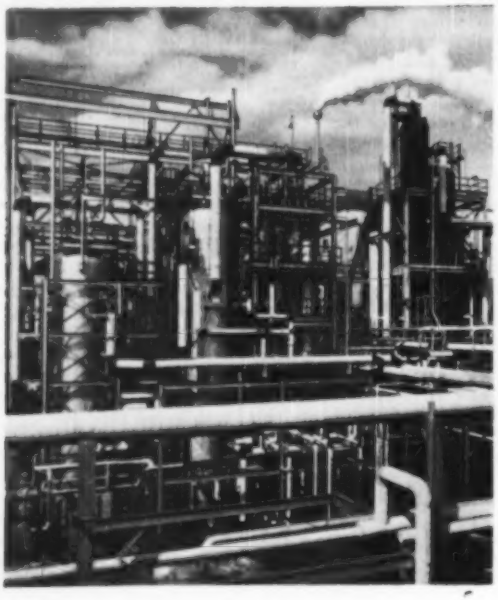


Above—A general view of Esso's Bayonne wax-making facilities, modernized by the M.E.K. plant, which produces 20 percent of the world's supply. Building in right background houses rotary filters which represent the heart of the process. Solvent storage tanks are shown in front of the building. Below—View of distillation recovery side of M.E.K. plant. On the left is seen the distillation units and the filter feed tank on the right.



Bayonne Modernization Includes New Wax Plant

DEDICATION of a modern solvents de-waxing plant, which replaces with a continuous and automatic process the traditional manual wax-making operation, was held May 15 at the Bayonne Refinery of Esso Standard Oil Company.

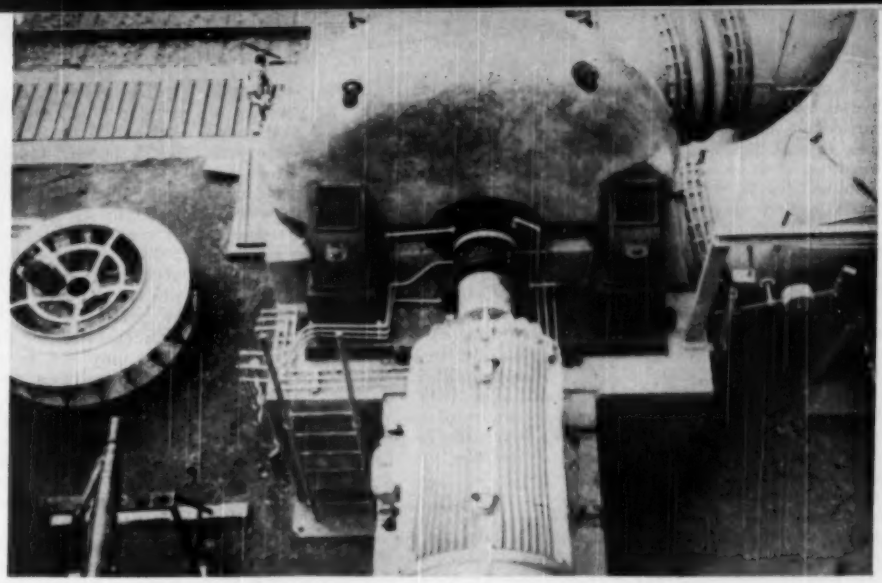
The new de-waxing unit (M. E. K. plant) will produce 178 million pounds of wax annually and completes the latest general modernization of the 75-year old plant, the oldest in the Esso Company and a specialty plant producing wax, lubricating oils and asphalt.

Stanley C. Hope is president of Esso and William Naden is an Esso director and general manager of manufacturing.

The modernization program includes the installation of a new boiler house and two new boilers capable of producing 400,000 pounds of steam per hour.

In the past, wax was separated from chilled oil in plate or frame presses. Solidified wax was retained on canvas cloth filters and the wax cake removed by hand scrapers. De-waxed oil flowed beneath the press and was processed into lubricating oils.

In the modern operation, a waxy feed stock is mixed with a solvent composed of methyl-ethyl-ketone, benzol and toluol. This lowers the viscosity of the oil feed and accelerates the separation of wax from the oil. Rotary filters effect the actual separation.



Circulating Hot Gas Blower for Preheater

High-pressure Hydrogenation Of Carbonaceous Matter

PART VI

THE VAPOR PHASE IN INDUSTRY (Section A)

PETER W. SHERWOOD
Koppers Company, Inc., Pittsburgh

THE principal function of vapor phase pressure hydrogenation is to convert high-boiling vaporizable oils into lighter products, and more particularly into gasoline. It differs in this function from thermal and catalytic cracking processes by producing solely gasoline (together with some liquefied petroleum gases), if so desired, without the simultaneous deterioration of some feed to heavy residue oils which is unavoidable in standard cracking operations.

The process is almost universally applicable to oils boiling below 620° F., regardless of their origin. The greatest amount of experience has been gathered for the conversion of the middle oils produced either during the liquid-phase hydrogenation process or by the topping of low-temperature carbonization tars. The process is, however, also highly suitable for the upgrading of cracking cycle stocks which are normally quite refractory but which can be rendered at least as amenable to further cracking as the virgin stock from which they are derived. By incorporating high-pressure hydrogenation into the refinery operation cycle (as has been done at the Baton Rouge, La., plant of Esso Standard Oil Company), it is therefore possible to derive much higher gasoline yields from crude oil stocks than can otherwise be obtained.

The gasolines produced in the course of the vapor-phase hydrogenation process are generally highly aromatic and possess good octane numbers. The hydrogen content of the products is not necessarily higher than that of the feed stocks.

***STRATEGIC** and economic considerations are placing high pressure hydrogenation into the limelight as a means of increasing the useful products obtainable from petroleum, and as a process for the production of liquid fuels from coal.*

This sixth article in a series of eight discusses hydrogenation in the vapor phase in which middle oils are upgraded to motor or aviation gasoline in yields unobtainable by any other commercial process.

Of controlling importance in the process are the catalyst, the partial pressure of hydrogen, and the operating temperature. The temperature level is determined by the activity of the catalyst and by the hydrogen content of the raw material. The earliest poison-resistant hydrogenation catalysts which attained industrial significance (Zn-Mg-Mo) required comparatively high operating temperatures, ranging between 840° and 930° F. The temperature level is determined by the raw material—aromatic raw materials, which are thermally more stable, require a higher temperature than do feed stocks rich in hydrogen. Operating pressure has been 3700-4400 psi. from the very beginnings of high-pressure hydrogenation.

The disadvantage of operation at the high temperatures required for the weakly active molybdenum base catalysts is twofold: 1) At the elevated temperatures, gas formation is high and gasoline yields are accordingly low. The hydrocarbon gases are fairly high in methane content under these conditions, which represents a very appreciable loss of valuable hydrogen. 2) Very highly aromatic oils cannot be satisfactorily processed unless very high hydrogen pressures are employed or unless the feed is prehydrogenated. This difficulty is, of course, due to the highly refractory nature of aromatic oils to cracking and splitting operations. The hydrogenation equilibrium must be displaced in the direction of naphthenic oils in order to render the charge more amenable to the desired breakdown reactions.

To minimize the gas formation, the hydrogenative splitting process is not carried out in a once-through operation. Instead, the product leaving the converter contains about 50 percent gasoline and 50 percent middle oil which must be recycled after topping (C-distillation). It is important that the hydrogen content of the C-middle oil be equal to or higher than that of the fresh feed. Otherwise, the recycle stock will be more refractory to splitting than the charge, the conversion rate will gradually deteriorate, and finally reach a dead point.

In order to overcome these difficulties, it was necessary to develop a poison-resistant catalyst which exhibits a high hydrogenating activity and suitable splitting characteristics at lower temperatures. I. G. Farbenindustrie was able to find such a catalyst in pure tungsten sulfide (5058) which was eventually used in the majority of English and German hydrogenation plants and is believed to have been also utilized in the United States.

This catalyst can be operated satisfactorily at temperatures between 790° and 840° F., whereby the exact temperature level is again determined by the hydrogen content of the feed stock. In order to maintain the activity of the tungsten sulfide catalyst, it is necessary to insure a minimum sulfur concentration (.4-.5 percent based on fresh oil charge) in either the oil or the hydrogen stream. The natural sulfur content of most oils treated by vapor-phase hydrogenation is adequate. In cases where the feed stock is deficient in sulfur, this element must be added either in its elemental form or as hydrogen sulfide. The latter mode of addition is generally preferred because it is possible to recover the hydrogen sulfide from the effluent gases and recycle it.

Mixed Catalyst, Improved Gasoline

The gasoline produced over tungsten sulfide catalyst 5058 is highly naphthenic and has, accordingly, a quite low octane number (68-70). With the increasing demands of the market on the knocking characteristics of gasoline, this product was no longer adequate. Eventually, a mixed catalyst was evolved, composed of 10 percent tungsten sulfide on Fuller's earth (6434), which was capable of producing gasoline in approximately the same yields as had been obtained over catalyst 5058, but of a much higher aromatics content, and therefore of a more satisfactory octane number. As in the case of pure tungsten disulfide, it is necessary to maintain the activity of the dilute WS_2 catalyst by maintaining a suitable minimum concentration of sulfur in the feed.

The new catalyst (6434) is not quite so rugged as 5058. The presence of alkaline nitrogen above 5 milligram/liter is deleterious as is also the presence of phenolic oxygen. The feed may not be too highly aromatic and must usually be upgraded by presaturation with hydrogen. The dilute tungsten sulfide catalyst is therefore generally employed with a feed stock which has been subjected to the hydrogenating and refining action of a pretreatment (presaturation) catalyst, (generally pure WS_2 or WS_2-Ni-Al_2O_3). The principal splitting function rests with the diluted (6434) catalyst. The octane number of the product gasoline can eventually be further raised by aftertreatment, e.g. by hydroforming.

Instance in Germany

Only one instance is known to this writer (namely at Lutzkendorf, Germany) where catalyst 6434 was used directly following the liquid phase, and without presaturation of the middle oil. In this case, the vapor phase was carried out at 10,300 psi. and the high hydrogen pressure was used to compensate partly for the failure to prehydrogenate the feed stock and thus render it into a form more amenable for splitting reactions.

The question whether the vapor phase over these tungsten catalysts should be carried out at 4400 psi. or 10,300 psi. has been the subject of considerable argument. For operational reasons it is often advantageous to operate both liquid and vapor phases at the same pressure and, to a certain extent, the requirements of the liquid phase are therefore controlling. There are, however, additional considerations which may overrule this operational synchronization.

The higher pressures permit higher temperatures and consequently increased thruput. It is, however, not indicated that this capacity boost is fully capable of paying the higher investment costs which are encountered at the greater pressures. There is, moreover, the important aspect of industrial safety to be considered. Certainly, at the present stage of development, operation at 4400 psi. has been more thoroughly explored and presents less difficulties and hazards. One more argument which may be raised against operation at highest pressures and temperatures is the proximity of this operating range to conditions promoting the thermal formation of methane and coke. If methane formation once sets in locally, this very exothermic reaction may well set off a chain of temperature boosts followed by uncontrollable methane and coke formation.

More recently, a catalyst has been developed as a substitute for presaturation catalyst 5058. Its composition is 25 percent tungsten sulfide plus 3 percent nickel, supported on activated alumina.[1] It carries out an excellent refining operation but is not so efficient a hydrogenating catalyst as 5058. This mixed catalyst is operated at temperatures of about 750° F. and pressures of 4400 psi. (Note that 5058 is operated at only 720-750° F. when it is operated for presaturation purposes only—i.e. as opposed to hydrogenative splitting, a function normally given over to 6434). Yields obtained with the mixed catalyst are, if anything, better than those obtained with pure tungsten disulfide.[2] The principal disadvantage of the new catalyst is a somewhat limited active life (about one year).

To obtain aviation-grade gasoline by high-pressure hydrogenation over tungsten base catalysts, it is necessary to subject the product to a final upgrading treatment. The 4400 psi. process for the manufacture of aviation gasoline consists therefore of three stages: 5058 presaturation, 6434 splitting, and hydroforming (or DHD—dehydrogenation at 750 psi.). A competitive single-stage process was developed by Ruhrol at Bottrop-Welheim. This process manufactured aviation gasoline of essentially equal quality and substantially the same yields as obtained by the 3-stage process over tungsten catalysts. The Ruhrol process employs a molybdenum-zinc-chromium-Fuller's earth catalyst which is not quite so active as tungsten-base catalysts. Accordingly it must be operated at a higher temperature, namely around 930° F.[3] To compensate for the higher temperatures, a fairly high recycle ratio and pressure of 10,300 psi. must be employed.

Aromatic Raw Material

Operation with the Ruhrol catalyst does not appear to be quite as versatile as is high-pressure hydrogenation over tungsten-base catalysts. The raw material for the 10,300-psi. process should be highly aromatic, or at least naphthenic. Paraffinic feed stocks are not quite so suitable.

The U. S. Bureau of Mines has taken much interest in the Ruhrol catalyst and has incorporated it into its demonstration plant at Louisiana, Mo.[4] This catalyst has been explored comparatively little, and further development of this process leaves a wider scope and opens up more potentialities than are still likely to be encountered in further study of the tungsten catalysts.

It is to be expected that a large-scale hydrogenation industry will not con-

fine itself to either 4400 or 10,300 psi. in either liquid or vapor phase. In the liquid phase, the selection of the pressure depends primarily on the raw material being processed. Judicious selection of operating pressure in the vapor phase permits the adaptation of the process to different feed stocks and, above all, to different products. Except in certain marginal fields, the Ruhrol and I. G. Farben vapor phase processes are probably complementary rather than competitive.

Industrial Operation of the Vapor Phase

1) Presaturation over Tungsten Sulfide

For reasons which have been pointed out above, the conversion of middle oils to gasoline at 4400 psi. is carried out in two stages. The function of the first stage (presaturation) is to refine the feed, i.e. remove the objectionable basic nitrogen and phenolic oxygen, and to render the oils more amenable to high-yield splitting in the second stage by raising the degree of hydrogen saturation. For this operation, pure tungsten sulfide has been found to be particularly active. In processes aiming at the manufacture of gasoline, tungsten sulfide may be usefully employed as first stage, no matter whether it is intended to subject the presaturated product to splitting under pressure or to atmospheric-pressure thermal or catalytic cracking. In the latter case, good gasoline yields can be obtained by returning the heavier cracking products (up to 610° F.) to the presaturation stage and there reconvert them into a highly suitable cracking stock.

The tungsten sulfide catalyst employed for presaturation is prepared by precipitation from an ammoniacal solution of tungstic acid by means of gaseous hydrogen sulfide. The product is dried in a nitrogen stream and finally heated to 840° F. in a stream of hydrogen.[5] The catalyst powder is extruded into 10 mm pellets which have an apparent specific gravity of 2.6. The catalyst is stored in a carbon dioxide atmosphere. When it is charged into the vapor phase converter, oxygen, derived from the impure purge nitrogen, is readily adsorbed on the catalyst. In order to prevent permanent damage to the catalyst, it is therefore necessary to prevent local overheating due to oxygen combustion by introducing hydrogen only very gradually.

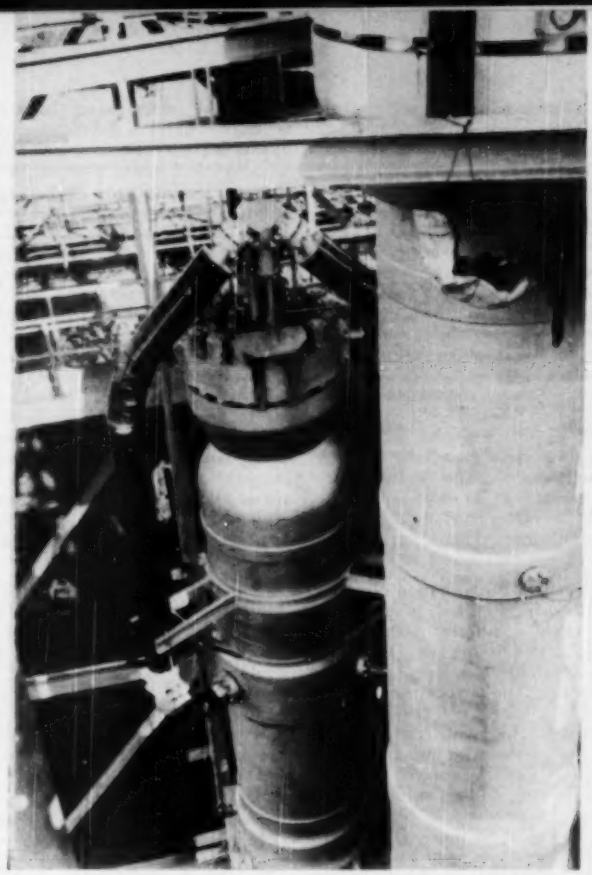
Pier[6] has pointed out some of the multifold reactions which take place over the tungsten sulfide catalyst. A study of his data (see Table 1) shows the versatility of the catalyst and indicates the variety of processes which it makes possible.

From these examples it can be seen that the refining and hydrogenation reactions, which the presaturation stage is intended to promote, take place at comparatively mild conditions and in good yield. Higher temperatures are required for isomerization and splitting. The presaturation stage is, however, not intentionally called upon to carry out reactions of the latter type. Mild conditions (720-750° F., 4400 psi.) are therefore selected for the industrial operation of presaturation hydrogenation. The process is carried out as a once-through operation.

In order to prevent polymerization and possible fouling of the catalyst, a low partial pressure of oil is desirable. In commercial practice, the feed contains about 8800 cubic feet hydrogen per barrel of oil. This ratio is increased in the course of the passage through the converter due to the admixture of hydrogen for cooling purposes.

Depending to a certain extent on the nature of the feed stock, between 2-3 percent of the carbon in the middle oil feed is found in the form of hydrocarbon gases in the product, i.e., the effective gasoline plus middle oil yield in the presaturation stage amounts to some 97-98 percent of theory. The weight yield depends, of course, on the amount of oxygen, nitrogen, and sulfur in the feed. The LPG consist of roughly one-half (by weight) butane, one-third propane, and the remainder methane and ethane in approximately equal proportions.

In spite of the mild conditions selected for the presaturation stage, the formation of appreciable quantities of gasoline by splitting cannot be avoided. In German plants the gasoline formation amounted to about 30 percent of the feed stock. Since the feed to the first vapor-phase stage often contained liquid-phase gasoline along with the middle oil, the product leaving the presaturation contained as much as 50 percent gasoline. It is not feasible to subject hydrocarbons in the gasoline range to the strongly splitting conditions of the second vapor-phase stage. The gasoline must therefore be separated between stages by distillation. The drawback of this operating procedure is: a) the need for an intermediate distillation, and b) the production of large amounts of gasoline of low-



View of Converter and Hot Separator.

TABLE 1

Reactions on Tungsten Sulfide

A. WITHOUT CHANGES OF THE CARBON FRAMEWORK

Type of Reaction	Example	Temp. °F.	Pressure Psi.	Partial Pressure of Oil psi.	Space Velocity Lbs. Oil/ Ft.³/Hr.	Percent Conversion per Pass
Hydrogenation of Olefins	Diisobutylene ——→ isooctane	420	3750	300	28.7	99
Hydrogenation of Aromatics	Naphthalene ——→ Decalin	633	3000	45	11.6	90
Naphthene Dehydrogenation	Cyclohexane ——→ Benzol	905	750	66	5.3	80
Reduction of Organic Oxygen, Nitrogen, and Sulfur Compounds	Presaturation of lignite middle oil with 18% phenols, 4% N-bases, 2.5% S-compounds	717	3000	120	13.0	99+

B. INVOLVING CHANGES IN THE CARBON FRAMEWORK

Isomerization	n-butane ——→ i-butane	750	3000	2700	6.4	35
Splitting of Paraffins	hexane ——→ methyl cyclopentane	705	3750	405	12.8	90
	middle oil (500-610° F.) ——→ gasoline (355° F.)	750	3300	75	12.8	90
Splitting of Naphthenes	decalin ——→ lower boiling gasoline	705	3300	90	14.0	90

octane rating. Presaturation operation at Billingham, England, is carried out in a slightly different fashion. The charge is middle oil from the liquid phase which has been completely freed of gasoline. The temperature is maintained at a lower level than has been reported for German plants. As a result, the presaturated product is low enough in gasoline content to permit direct feeding to the splitting stage without intermediate distillation. Indeed, according to Gordon,[7] these two vapor-phase stages have been so thoroughly synchronized and have become so reliable in their operation that no provision need be made for the storage of the presaturation product.

It is probable that the above advantages are achieved at the cost of some useful gasoline yield in the splitting stage.

Typical thruput rates through the converter range from 37.2 lbs. middle oil per cu. ft. catalyst per hour in the case of highly aromatic feed to 93 lbs./ft.³/hr. for highly paraffinic oils.[8] Depending on the degree of hydrogenation required, hydrogen consumption varies between 3.5 and 5 percent of the weight of the middle oil in the feed stock.

The composition of the product depends on the nature of the raw material and on operating conditions. A representative product obtained from low-temperature lignite tar is reported to contain 10 percent aromatics, 40 percent naphthenes and 50 percent paraffins.[8]

Considerable exothermic heat is developed in the course of the presaturation stage. The usual arrangement for removal of the heat involves the introduction of cold hydrogen at various points in the converter. More recently, the utilization of this heat has been suggested by means of an external coolant which can be cycled to a waste heat boiler.[9] Presaturation of one pound of middle oil will result in the evolution of 180-270 Btu.[8] and calls for the use of about 17-25 cubic feet of cooling gas if the temperature variations are to be maintained within the required limits (permissible variation is about 35° F.).

The general flow scheme of the presaturation stage (as well as of the other vapor-phase stages) is not unlike that already described for the liquid phase. The feed stock is boosted to the desired operating pressure and is joined by high-pressure hydrogen at a point preceding the regenerative heat exchangers in which most of the required sensible heat is supplied by the effluent products of the reactors. A final temperature boost is given to the combined charge in a preheater furnace which may be either gas-fired or electrically heated. Objections to electric preheater furnaces which have been outlined in connection with the liquid phase (see Part IV, PETROLEUM REFINER, March, 1950) do not apply to vapor-phase operation. Electrical units require less first investment than do gas-fired furnaces of the same capacity and have the additional advantage of permitting more accurate heat control. Such units have been employed commercially with considerable success.

The preheated feed enters the converters in which the catalyst is arranged in several layers supported on grates. Baffles are provided in the unpacked spaces in order to promote intimate mixing with cold hydrogen which is added at these points for cooling purposes. The flow is preferably from top to bottom, an arrangement which minimizes the danger of catalyst obstruction due to dust formation.

The products leaving the converter pass through the regenerative heat exchangers and finally via a water cooler to a high-pressure cold catchpot. The gaseous phase of the catchpot is recompressed and recycled to the reactor inlet. The bottoms are let down to atmospheric pressure in two or three successive stages. As in the case of the liquid phase, the first let-down stage evolves a lean gas consisting primarily of hydrogen. The disposition of this gas stream varies at different plants. The usual practice is to use it for fuel purposes but it may also be subjected to low-temperature separation of its components. The rich gases evolved in the second and third stage contain almost the entire gas make of the presaturation stage. An oil washing operation for the recycle hydrogen is therefore obviated.

Need of Water Scrubbing

It is often not feasible to keep the hydrogen streams of the presaturation and splitting phases separate. The gas leaving the presaturation stage is, however, usually rich in ammonia which originates from the organic nitrogen compounds contained in the feed stock. At the same time, it has already been pointed out that the nitrogen compounds have a deleterious effect on the operation of the dilute tungsten sulfide catalyst in the splitting stage. It is, therefore, generally necessary to subject the hydrogen stream leaving the presaturating stage to a thorough water scrubbing.

For the same reason it is necessary to wash the oil product of the first vapor phase with acid and water before permitting it to enter the splitting converters.

Depending on the gasoline content of the oil product, an intermediate distillation may or may not be required between the two vapor-phase stages. (See previous discussion of this subject.)

A great many oils subjected to presaturation have sufficient sulfur content to fill the requirements of the tungsten sulfide catalyst. However, in the course of this refining stage, essentially the entire sulfur content is removed in the form of (recoverable) hydrogen sulfide. The oil passing to the splitting stage must, accordingly, have a suitable quantity of hydrogen sulfide added in a "doping" plant. Most of the gas is again recovered from the effluent of the splitting stage.

England Development

An interesting development distinguishes presaturation operations at Heysham, England.[7] The oil at this

plant demanded a particularly low operating temperature and low contact time. Furthermore, this feed stock exhibited a higher boiling range than is customarily employed in the vapor phase. In order to insure complete vaporization, an unusually high hydrogen ratio, calling for very large pipeline sizes, would have been required. It was, therefore, decided to carry out the operation in the liquid phase. Special provisions were made in the converter to assure even distribution of the entire charge over the whole area of the catalyst bed. The operation proved successful, but is limited in scope to oils which are comparatively low in unsaturated components with a tendency to polymerization and consequent deactivation of the catalyst. This mode of operating is reminiscent of the low-temperature hydrogenation processes for the manufacture of specialty products which will be discussed later.

2) Splitting

Strongly hydrogenating catalysts of the type now employed for presaturation can be utilized successfully for the conversion of middle oils to gasoline by splitting. The temperatures which must be chosen for such operation are higher than for presaturation conditions and gas formation is accordingly greater. Furthermore, the gasoline produced is rich in hydrogen and exhibits a lower octane number than is generally permissible. By raising the temperature still farther (say to 940° F.), it becomes possible to obtain a more highly aromatic gasoline, with better octane number. However, unless an unduly large recycle ratio is employed, such conditions will lead to excessive gas formation at 4400 psi.

Highly active splitting catalysts have been developed which are capable of carrying out 60-70 percent conversion satisfactorily in a once-through operation at low temperatures (770° F.) and in excellent yields. In today's high-pressure hydrogenation plants the most common of these is diluted tungsten sulfide on a Fuller's earth base.

The catalyst is prepared by mixing Fuller's earth with a 10 percent HF solution containing enough tungstic acid to yield a catalyst bearing 10 percent WS_2. The product is dried and is then sulfided in an H_2S—H_2 atmosphere. The powder is cooled and pelleted after the addition of water. Final drying is effected in an air stream, followed by heating in a stream of hydrogen.[10]

This catalyst and similar types have been widely employed for the splitting hydrogenation of a large variety of feed stocks, ranging from the middle oils of liquid phase hydrogenation (usually after presaturation) to naphtha bottoms and cycle gas oils obtained in petroleum refinery cracking operations.

The catalyst requires the presence of sulfur. The optimum is 2 percent by weight (based on middle oil) but the advantages of exceeding a sulfur content of 1 percent are comparatively too small to warrant higher concentrations in industrial operation. The sulfur is commonly added in the form of hydrogen sulfide.

The sensitivity of these diluted catalysts to nitrogen bases and oxygen has already been pointed out and is the main reason for the institution of the presaturation stage.

Typical operating temperatures is 750-790° F. at 4400 psi. Throughput rates of 75 pounds feed oil per cubic foot of catalyst per hour are attained.

The splitting stage is equipped and operated in essentially the same manner as has been described for the presaturation stage.

The above operating conditions serve to produce a gasoline with a clear octane number of 73-74 (Motor method). Where it is desired to produce aviation-base gasoline, it is either necessary to subject the product of the splitting stage to further processing or to operate at more drastic time-temperature conditions. In either case, there will be additional yield losses of approximately the same order of magnitude (over-all motor gasoline yields—excluding butane—amount to 88-90 weight percent compared to only 74-77 percent in the case of aviation gasoline). The main advantage of operating an afterprocessing stage for aviation gasoline production rather than operating at lower throughput in the high-pressure splitting stage is the more efficient utilization of costly high-pressure reaction space.

Another Catalyst

The only 4400-psi. splitting catalyst other than the dilute tungsten catalyst described above which is known to have been operated commercially is an iron catalyst (231) which has been employed for the manufacture of aviation gasoline at Billingham (actual operating pressure at this plant is only 3750 psi.). This catalyst permits operation at low temperatures (705° F.) and produces a gasoline with a clear octane number of 78-80 from stock which produced O.N.75 gasoline over dilute tungsten sulfide (6434) at 752° F. It is not quite clear why this catalyst was preferred at Billingham over the dilute tungsten sulfide catalyst which this plant had previously operated for the production of motor gasoline. The gain in octane number and volatility (72 percent at 100° C. compared with 45 percent at 100° C. for 6434 motor gasoline) was achieved at the cost of about 25 percent in splitting stage capacity and 12.5 percent in over-all yield. Very similar results are obtained by operating the dilute tungsten sulfide catalyst at higher temperatures or lower throughput rates.

Sachanen[11] points out that the high conversion per pass (60-70 volume percent) can be achieved in high-pressure splitting regardless of the individual properties of the charging stock. This is in striking contrast to low-pressure cracking operation. The reason for this remarkable difference is, above all, the complete elimination of coke formation. The activity of the catalyst and the temperature are the primary factors determining the conversion per pass.

An important characteristic of the strongly splitting and aromatizing catalysts employed in the splitting stage is their strongly pronounced isomerization action. A typical composition of the hydrocarbon gas formed during the vapor-phase operation for motor gasoline production is: 83 weight percent butane (of which 75 percent is isobutane) 15 percent propane and about 1 percent each ethane and methane. An important corrolary of this propensity for the production of isobutane is the ready availability in hydrogenation plants of raw materials for isooctane production.

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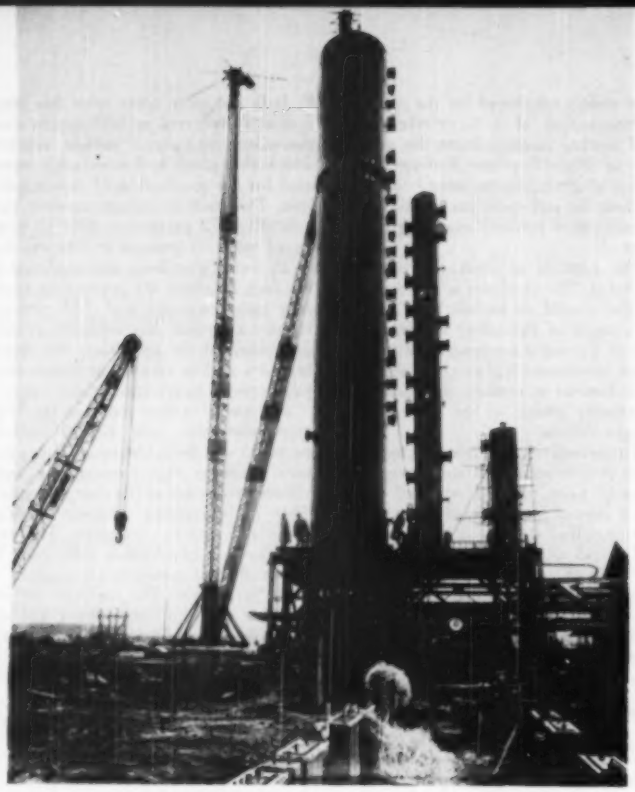
Good Progress on Refinery at Grangemouth



Tower Being Plumbed, Anglo-Iranian Oil Company Limited-Scottish Oils Limited Grangemouth Refinery Expansion Project.

THE British refinery expansion program is continuing to make good progress toward its ultimate goal of self-sufficiency by the end of Marshall Plan aid.

Among several others, excellent progress is being made at the Grangemouth plant of Scottish Oils Ltd., which is situated on the Firth of Forth, midway between Edinburgh and Glasgow in Scotland.

The present crude import of the refinery is approximately 4,200,000 barrels a year and plans are now well in hand for extending the crude capacity to three times this figure.

In addition to the installation of much new refinery equipment, new facilities are being constructed on an adjacent site for the manufacture of organic chemicals from petroleum.

Scottish Oils Ltd. is a subsidiary of the Anglo-Iranian Oil Company and the petrochemical plant will be owned and operated by British Petroleum Chemicals Ltd., a company which is owned jointly by the Anglo-Iranian Oil Company and Distillers Ltd.

At Grangemouth there are at present five conventional shell stills and distillates from these crude stills are treated in the vapor-phase with caustic soda and are run to produce closer fractionation. There are also two small vapor-phase continuous-cracking plants which are at present being operated as topping units.

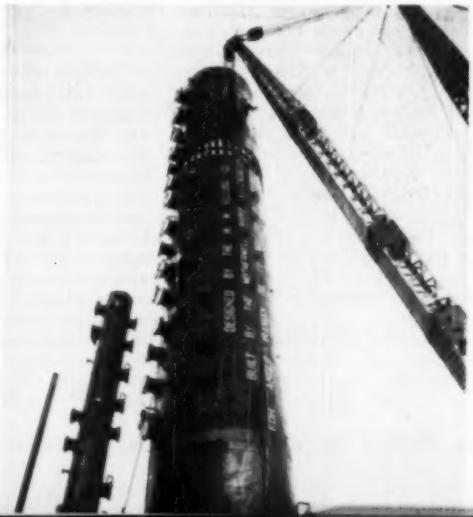
Current expansion contemplates installation of a new 30,000-barrel-daily crude oil topping unit; a 3000-barrel-daily phosphoric acid treating plant; and an 8000-barrel-daily copper chloride treating plant.

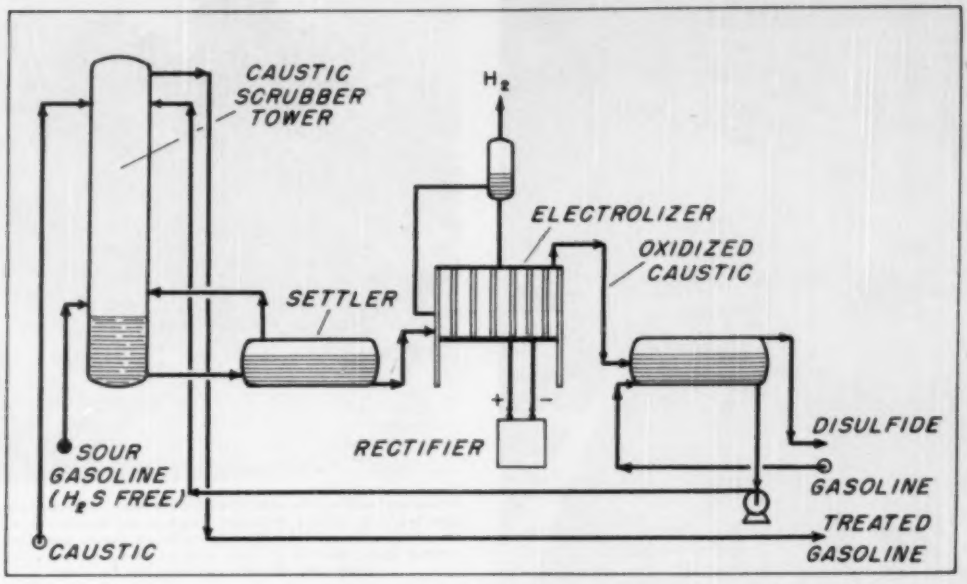
The charging stock for the phosphoric acid plant will be naphtha, derived from the adjacent refinery. Excess cracking spirit will be returned to the refinery for phosphoric acid treatment and inclusion in the marketable gasoline.

Accompanying photographs show the erection of the main fractionating column of the topping-stabilizing unit. This tower is 96 feet high, 13 feet in diameter and weighs, without its internal fittings, about 67 tons. It was manufactured in Scotland and transported by highway from Motherwell to Grangemouth. The base of the tower is approximately 20 feet from ground level.

Preparatory Lift Complete.

Tower Plumbed, Slings Being Removed.





Flow Diagram for the Gaylor Process

Gaylor Caustic Recovery Process

THE Gaylor process is used to regenerate spent caustic obtained during the sweetening of sour naphthas and similar products. Although it will also oxidize hydrogen sulfide, it is preferable and more practical to scrub out H_2S with a preliminary scrubber.

The process, developed by the American Development Corporation, New York, will be licensed by this same company.

The process depends upon electrolysis of the spent caustic to produce nascent oxygen which immediately oxidizes mercaptans and other oxidizable sulfur compounds to disulfides, etc., which are removed in a subsequent settling operation.

The spent caustic leaving the gasoline scrubbing tower is preferably first settled to remove any entrained hydrocarbon and then passed into an electrolyzer having conductive charged electrodes separated by insulating diaphragm plates which are permeable to liquid but impermeable to gas. On the one side of the diaphragm, hydrogen is liberated and is drawn off for introduction into other processing operations, or for discard. On the other side of the diaphragm, nascent oxygen is liberated and this reacts with mercaptans to produce disulfides which are insoluble in the caustic and separable as an oily layer.

The oxidized caustic stream is run into a separator where the oily disulfide layer is drawn off, and a small flow of gasoline may be introduced into the settler to facilitate complete removal of the disulfides. Thereafter, the regenerated caustic is pumped back to the caustic scrubbing tower for further sweetening operations.

Direct current is provided for the electrolyzer by means of a rectifier or motor-generator.

Electrolysis is carried out at ambient temperature, and no heating, steaming or heat exchange are required. Low pressure, sufficient to insure flow through the electrolyzer is all that is necessary, and a low voltage-high current source, sufficient to liberate just enough oxygen for the conversion, and no more, is preferred.

The amount of mercaptans oxidized depends upon the flow through the electrolyzer. At a fairly rapid flow rate, conversion in excess of 75 percent has been achieved with energy efficiency in the neighborhood of 0.6 pound sulfur removed per kwh.

The advantages of the Gaylor process over other methods for regenerating caustic soda, according to its developers, include:

1) Reduced operating cost due to elimination of steam, water and air. Electrical energy is used very efficiently to regenerate the caustic at a cost considerably below that of utilities required for other processes.

2) Reduced investment costs due to less equipment needed.

3) Reduced maintenance cost, since electrolysis is carried out at ambient temperature, and no heat exchangers, condensers or coolers are required.

4) Reduced caustic soda cost due to increasing life of the extractant.

5) Low sodium mercaptides are not regenerated with steam but are readily oxidized electrolytically.

6) Saving on TEL requirement because of improved mercaptan scrubbing efficiency on naphtha, resulting from improved regeneration of spent caustic.

Preliminary work on the more than $100 million Anglo-American Oil Company, Ltd., refinery at Fawley, England, was handled by a large labor force and some 175 bulldozers, trucks and cranes, one of which is pictured above. Millions of cubic yards of earth and many acres of timber were cleared to accommodate the plant.

Natural ballast from the surrounding area is washed and graded in the aggregate plant, pictured at the left.

Foundations for Catalytic Cracker Laid at Fawley

PREPARATORY work for the construction of the new Esso refinery at Fawley, England, now having been largely finished, the first major stage in the construction of the refinery proper has recently been started with the laying of the foundations of the fluid catalytic cracking plant. When completed, this plant will produce a million gallons of gasoline daily and will be the largest in Britain.

The area filled in with concrete extends over 5000 square feet and in some places the foundations go down twelve feet. One of the most modern concrete and aggregate plants of its kind in the world has been in operation at the plant site since January.

A precasting yard has been extended in order to increase the output of pipe sleepers and catch basins.

The land about the new refinery contains a great deal of suitable gravel from which the top soil was removed last autumn. This will be replaced when the concrete plant is dismantled. Bulldozers pushed the gravel-laden earth toward the orbit of a drag-line crane, which dumped the natural ballast into the feed hopper of the aggregate plant.

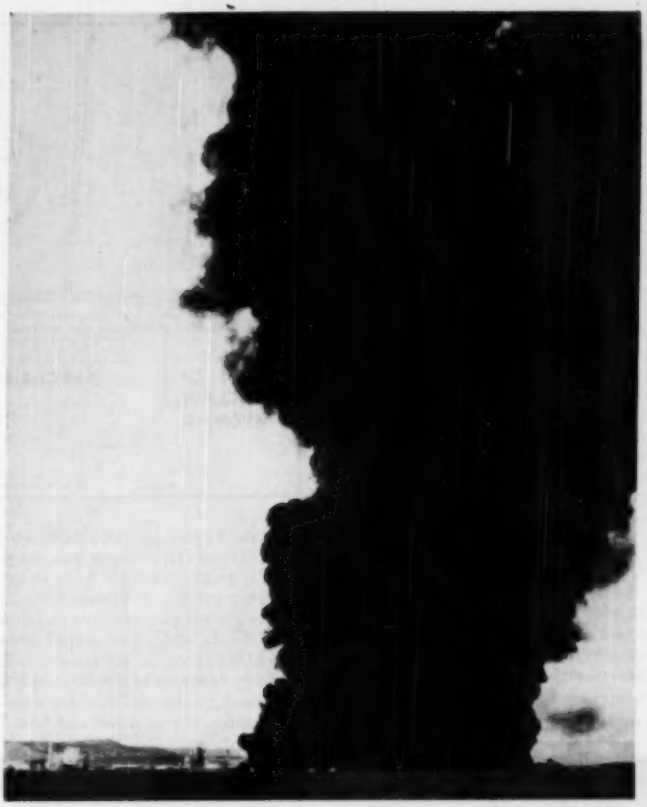
The most economical use of water is insured by means of arrangements which enable the same water to be used over and over again. After the water has been used for gravel washing, it flows back to the pond by gravity through a series of settling basins. A well furnishes the natural storage of the pond.

On the far side of the concrete plant is a cement storage shed. Four hundred tons of cement a week are being delivered and this is carried by mechanical conveyor to the cement hopper at the top of the concrete plant.

Trucks are used to transport the concrete to the refinery site.

The new refinery at Fawley, of which the "cat cracker" is an important part, is being built by Anglo-American Oil Company Limited. When it is completed in 1951, it will produce more than 35 million barrels of petroleum products a year and will be the largest oil refinery in Europe.

The concrete and aggregate mixing unit being used in construction of the new Esso refinery, Fawley, England, is pictured at the left. Mixers dump concrete into wagons at the rate of 120 cubic yards an hour. The conveyor belt for sand and gravel leads up from the right center of photo. The cement hopper is seen on the left.



Looking south toward Sinclair Refining Company's refinery at Sinclair, Wyo., about eight hours after tar reservoir fire started. A portion of the refinery can be seen in the lower left background.

Spontaneous Combustion Causes Tar Reservior Fire

J. S. CORLEW
Technical Assistant, Sinclair Refining Company, Sinclair, Wyoming

SPONTANEOUS combustion was the apparent cause of a spectacular fire on June 17, 1949, which eventually consumed an estimated 500,000 barrels of petroleum waste tar and acid sludge contained in earthen reservoirs adjacent to Sinclair Refining Company's refinery at Sinclair, Wyo. Damage was confined to the loss of the petroleum tar and acid sludge and no one was injured.

This experience should serve as a warning to refineries to avoid storing mixtures of highly cracked tar and sulfuric acid sludge, since it appears that spontaneous combustion may develop from such mixtures when stored over long periods of time.

The difficulties in fighting a fire of this nature which covered such a large surface area should be recognized. In this case the fire ran its course until the fuel supply was exhausted.

Cause of Fire

The earthen reservoirs had been used to receive the discard of petroleum waste tar during the late 1930's when coking operations at this Wyoming plant were discontinued, and when there was no market for the tar produced from thermal cracking operations. During the war, a large quantity of spent alkylation acid was pumped into reservoir No. 1, and later a break in the dyke between the reservoirs allowed the acid to flow into reservoir No. 2. No. 1 reservoir is about 900 feet long and 300 feet wide and No. 2 reservoir is about 1050 feet long and 400 feet wide. The bottoms of both reservoirs have a general slope to the east with a maximum depth of 12 feet in No. 1 reservoir and 14 feet in No. 2 reservoir. Tar and acid sludge in the two reservoirs covered approximately 650,000 square feet of surface at the time of the fire.

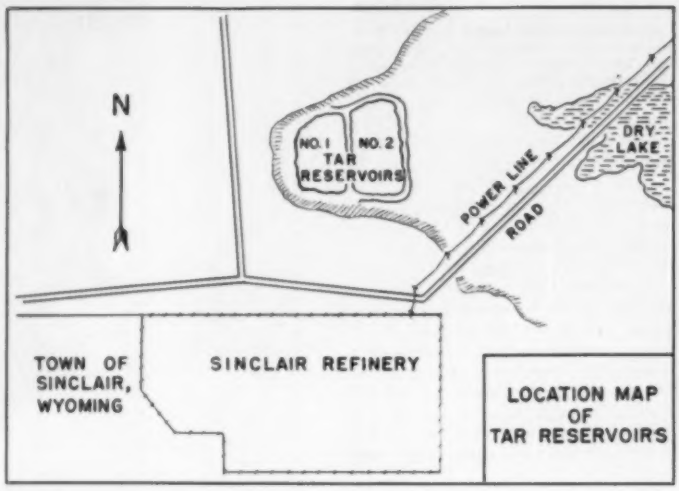
On two previous occasions, in December, 1948 and again in January, 1949, small fires started spontaneously in reservoir No. 1. Both times it was possible to extinguish the blaze with water, since due to the cold weather the tar did not readily flow except in the immediate area of the fire, and the fire did not spread over the entire surface of the reservoir. At the time of the December fire, it was necessary to lay a water line from the refinery to the reservoirs in order to extinguish the flames.

The tremendous blaze in June was preceded by heavy rainstorms which washed out a portion of the east dyke of reservoir No. 2. Partial repairs to the dyke were completed just a few hours before the fire started. It is believed that the heat evolved by the reaction of the sulfuric acid on the highly unsaturated tar over a period of years finally developed a high enough heat level to cause spontaneous combustion. It is also possible that the heat of dilution of the acid with water from rain and snow contributed to the amount of heat evolved. The reaction of the sulfuric acid and tar was probably quite slow at first and accelerated as heat was evolved from the reaction. It was apparent during the course of the fire that sufficient heat was released in certain areas to cause further cracking of the tar which produced large volumes of gas and resulted in huge roaring infernos in these areas.

Fire Spread Rapidly

The fire started in reservoir No. 2 at approximately 10:30 p. m. June 17. Soon after the fire was discovered, the entire surface of reservoir No. 2 was in flames. Shortly thereafter the fire jumped to reservoir No. 1 and by 5:00 a. m., at which

time the accompanying photographs were taken, both reservoirs were burning briskly. The column of smoke produced from the blaze in both reservoirs was about 1500 to 2000 feet in diameter and rose to a height of 4000 to 5000 feet in the air. The smoke column was plainly visible for a radius of more than 120 miles. After the flames had completely covered reservoir No. 2, the tar boiled over the east dyke and ran down toward the power line and road which lead to the river pump station. The river pump station is located on the North Platte River and supplies water for both the refinery and the town of Sinclair. The tar boiling over the east dyke caused considerable concern in that it might possibly burn out the power line and go over the road bed as shown on the accompanying map. A secondary dyke was built to confine the overflow which stopped as soon as the fire had consumed enough oil to drop the level in the reservoir.

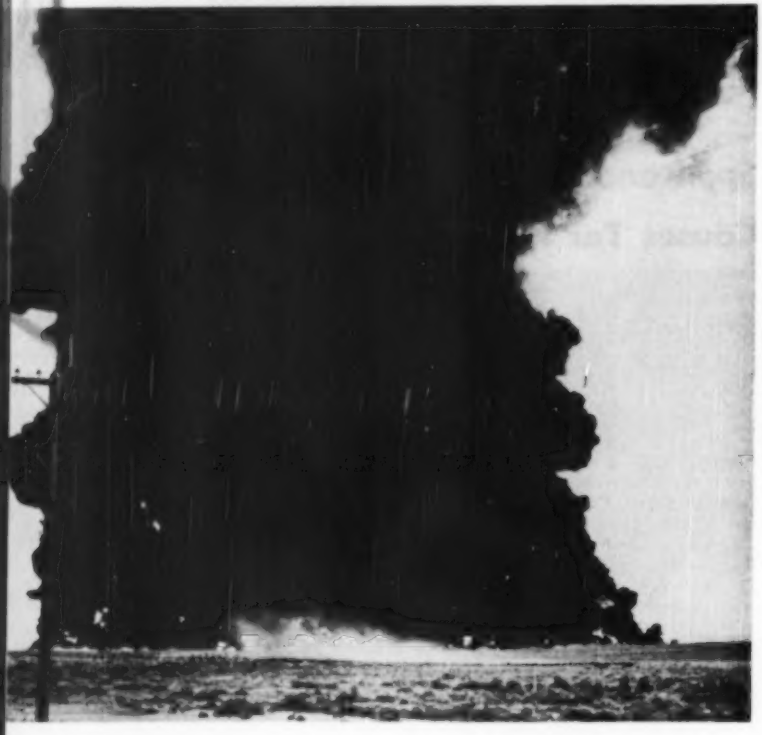


Method of Fighting Fire

An attempt was made to confine the fire with water streams during the first, second and third day; however, it soon became evident that it would not be possible to extinguish the blaze. Water streams on the burning tar produced a foam which was quite effective in smothering the flames over the area which the foam covered. However, it was not possible to produce enough foam to cover the entire surface of the reservoirs. Further, it was not possible to reach burning piles of coke which had heaved upward toward the center of the reservoirs during the violent early stages of the fire. The burning coke piles provided a source of reignition to tar which had been extinguished. Since fighting the fire with water streams proved ineffective, it was decided to let the fire run its course and consume the volume of tar and acid sludge in the resrvoirs. It was also felt that even if the fire were extinguished, possible reoccurrence of the blaze was very likely.

Fortunately, strong winds from the southwest prevailed during the entire course of the fire. Had the wind direction changed to carry the smoke over the town of Sinclair and refinery, it is probable that considerable damage would have been experienced. The heavy smoke contained particles of unburned tar and soot which dropped out of the main portion of smoke as it left the updraft of the fire. The refinery was in constant contact with weather reporting stations for predicted wind direction and velocities.

The tar reservoirs burned for a period of about 10 days, after which time only smouldering piles of coke remained. Some of these coke piles are still burning almost a year after the initial fire. The tar consumed by the fire resulted in a maximum drop in level of 8 feet in reservoir No. 1 and 10 feet in reservoir No. 2. These figures do not indicate the average drop in level because of the sloping and irregular contour of the reservoir bottoms.



← Looking west toward the lower dyke of No. 2 reservoir. Note tar spilling over dyke wall. Power lines in foreground.

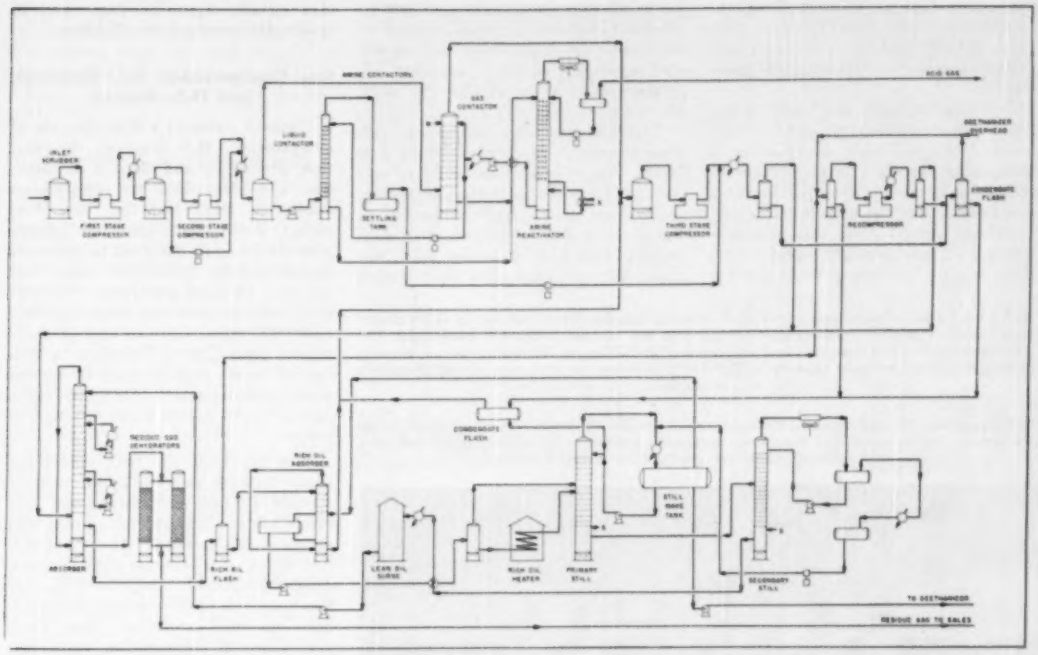


Figure 1. Flow Diagram of Compression, H_2S Removal, Dehydration, Absorption and Distillation Units of the Fullerton Gasoline Plant.

West Texas Gasoline Plant Is Formally Opened

J. M. HILLSMAN and E. W. KILGREN
Stanolind Oil & Gas Company, Tulsa

THIS NEW gasoline plant, culmination of the joint efforts of 15 oil producers to conserve casinghead gas produced in the South Fullerton field, collects gas from 65 tank batteries at 10 psig. (2 psig. at the plant) to produce 180,000 gallons daily of liquid fuels. A residue gas system supplies sweet gas to all leases in the field.

One of the unusual features of the process, representing a departure from the conventional methods, is use of a six-plate rich oil absorber to absorb a substantial part of the propane and heavier materials in the still make-tank vapors. Overhead from this absorber, and low-pressure condensate flash vapors, are recompressed and charged to the main absorber. A separate recompressor handles other flash gases for recycle to the main absorber. Also, the plant contains H_2S removal and dehydrations units.

THE South Fullerton gasoline plant, 17 miles northwest of Andrews, Texas, was opened for inspection by the public, May 21. The plant, of which C. J. Tighe is superintendent, is operated by Stanolind Oil and Gas Company for the group of 15 owners. Operation was begun January 31. Final construction was completed in February.

TABLE 1
Gas Composition

COMPONENT	Mol Percent
Nitrogen	3.66
Hydrogen Sulfide	.51
Carbon Dioxide	.48
Methane	64.47
Ethane	13.93
Propane	9.16
Butanes	4.45
Pentanes	1.99
Hexanes	.90
Heptanes and Heavier	.45
	100.00

The plant, another example of casinghead gas conservation that has resulted from joint efforts of oil producers, is jointly owned by ten companies and five individuals. The owners are Stanolind Oil and Gas Company, Mid-Continent Petroleum Corporation, Texas Pacific Coal and Oil Company, The Superior Oil Company, Gulf Oil Corporation, The Texas Company, Anderson-Prichard Oil Corporation, Elizabeth F. Frankel, The British American Oil Producing Company, The Bay Petroleum Corporation, Pearl Frankel, Champlin Refining Company, Paul F. Barnhart, Donald Frankel, and Harding Frankel.

Design of the plant provides for an ultimate capacity of 55 million standard cubic feet of gas per day, but presently has compressor capacity for only 38 million feet per day. When processing 38 million feet of gas per day of

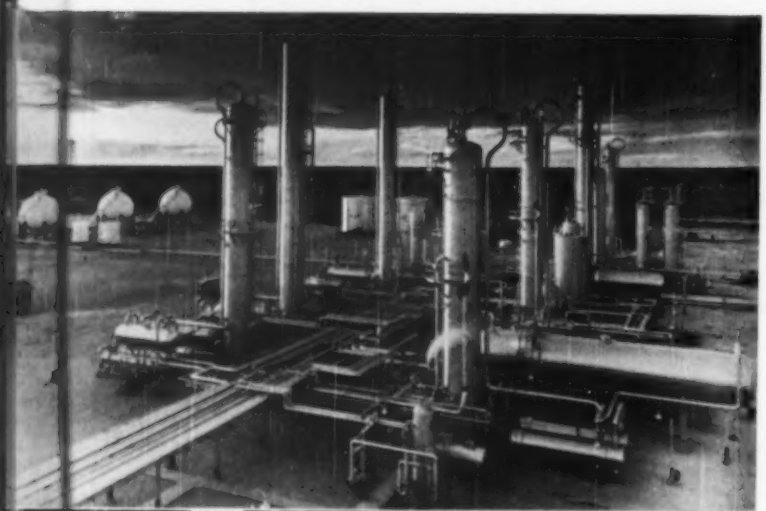
the composition in Table 1, the plant can recover daily 80,000 gallons propane, 50,000 gallons of butane, and 50,000 gallons of debutanized gasoline.

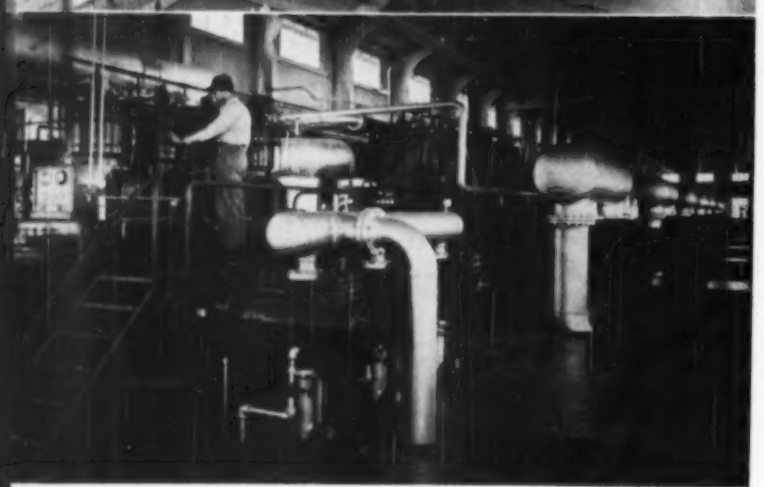
The process cycle employed by the plant has a number of unusual features. A six-plate rich oil absorber is utilized to absorb a large portion of the propane and heavier components contained in the still make-tank vapors. Overhead vapors from this absorber, along with low-pressure condensate flash vapors, are recompressed through the third stage compressor and sent to the main absorber for final removal of the desired products. Other flash vapors are recompressed in a separate recompressor for recycle to the main absorber.

The field gas gathering system collects separator gas from 65 tank batteries. The system is designed to collect gas from the separators operating at 10 psig. and to deliver the gas to the plant at 2 psig. Branch lines connecting the well batteries feed two main delivery lines. The field system also includes a residue gas system to return dry sweet gas to all leases.

Below, top picture—Process area of the South Fullerton Gasoline Plant from the top of the direct-fired heater. A portion of the product storage area can be seen in the left background. The processing equipment is designed for a capacity of 55,000,000 cubic feet daily; however, capacity is limited by the compressor capacity to 38,000,000 cubic feet for production of 180,000 gallons of liquids.

Bottom picture—Engineer checking the power cylinder on the 400 horsepower recompressor. In the background are the seven 1600 horsepower compressors capable of compressing 38,000,000 cubic feet daily of casinghead gas from the Fullerton field.





Gas Compression, H_2S Removal, and Dehydration

Figure 1 presents a flow diagram of compression, H_2S removal, dehydration, absorption and distillation facilities. The plant field gas compressors consist of seven 1600 hp. (sea level rating) two-cycle, right-angle gas-engine driven units designed to compress approximately 38,000,000 cubic feet per day of field gas from 2 to 700 psig., and to compress approximately 5,400,000 cubic feet per day of cycle vapors from 220 to 700 psig. A 400-hp. two-cycle unit is used to recompress approximately 7,200,000 cubic feet of cycle vapors from 425 to 700 psig.

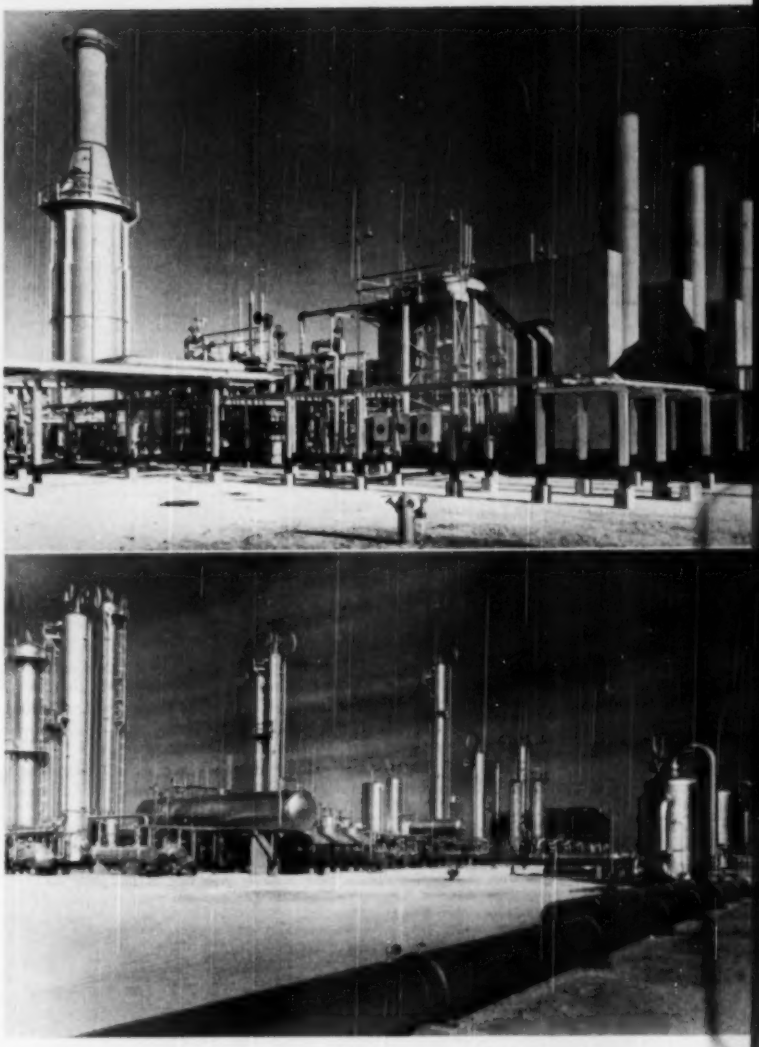
Wet gas from the field enters the plant through two 9x12-foot vertical scrubbers where entrained water and crude oil are trapped out. From this scrubber gas enters the first stage suction header at a pressure slightly above atmospheric, and is compressed through two stages to approximately 225 psig. Sour gas and condensate from these two stages of compression are separated and sent to the acid gas removal system. The condensate is pumped through a packed tower countercurrently to amine solution. The gas is passed through a bubble tower for contacting with amine solution. The foul amine solution from these columns is combined and sent to the reactivator after heat exchange with the hot reactivator bottoms. The reactivated amine solution, after heat exchange, is pumped through coolers to the gas and liquid contactors. The reactivator overhead vapors, consisting of acid gases and steam, are passed through an air cooled condenser where most of the steam is condensed. The condensate from the overhead vapors is pumped back to the tower as reflux. The trap-out type reboiler is heated with exhaust steam from process pumps.

The sweet gas from the amine contactor is joined by recycle vapors from the 265 psig. compressor condensate flash and the rich oil absorber residue. These combined streams are compressed to 700 psig. by the third-stage compressors. Sweet condensate from the amine contactor is joined with the compressed gas to aid condensation in the cooler. Gas from the discharge scrubber, along with the recompressor discharge vapors, is sent to the main absorber. Condensate from the discharge scrubber joins the condensate from the recompressor and is flashed at 435 psig. This condensate is then joined by any condensate which might

be collected in the recompressor suction scrubber and flashed to 265 psig. The vapors from this flash recycle to the third stage compressors, and the liquid is used for wash-back in the primary still.

Absorption and Distillation

The main absorber, operating at 700 psig., is designed for a lean oil circulating rate of approximately 500 gpm. Residue gas from the absorber is dried by solid desiccant-type dehydrators to meet sales gas specifications. The absorber is equipped with two intercoolers with a total duty of approximately 3,200,000 Btu. per hour. Rich oil from the absorber is flashed to 435 psig. Vapors are sent to the recompressor and the rich oil is sent to the 225 psig. rich oil absorber to effect recovery from the still make-tank vapors. Rich oil from the rich oil absorber is pumped through the rich oil-lean oil exchangers to a hot vent tank operating at 350 psig. and about 325° F. Vent vapors flow directly to the primary still, operating at about 240 psig. The oil is further heated to 500° F. in a direct fired heater before entering the still. Stripping steam is introduced at the bottom of the tower at a design rate of approximately 2000 pounds per hour. Lean oil is washed back in the rectifying section by condensate from the 265 psig. compressor condensate drum at a design rate of about 200 gpm. A reflux pump for pumping from the make-tank is provided to supplement the wash-back if necessary. After being partially stripped in the primary still, the rich oil flows to the secondary still operating at about 70 psig. where it is completely stripped with steam at a design rate of approximately 6700 pounds per hour. Reflux is obtained by cooling the overhead vapors to 160° F. with air cooling. The design reflux rate is 94 gpm. The net overhead is totally condensed by water cooling and is pumped to the primary still condenser to minimize the quantity of recycle vapors from the still make-tank.



Above, top picture—The direct-fired heater at left has a capacity of 28 million Btu's per hour, and the three boilers at right can supply the plant with 40,000 pounds per hour of steam.

Bottom picture—South Fullerton gasoline plant. Pipeline in foreground supplies plant with gas from the field. The process area is at the left and the compressor scrubbers at right.

Fractionation and Product Treating

Figure 2 presents a flow diagram of the fractionation and product treating facilities. Raw-make from the still make-tank is pumped to the de-ethanizer operating at 460 psig. The de-ethanizer feed is first heated to about 140° F. by heat exchanging with the depropanizer bottoms and is then further heated in a steam pre-heater to about 160° F. The gross overhead vapors are partially condensed to make reflux and the vapors are sent to the recompressor. The tower bottoms are sent to the depropanizer where propane is the overhead product. The propane is pumped through a caustic wash to remove traces of sulfur compounds. It then passes through a sand filter to remove entrained caustic, and is dried in solid desiccant-type driers. From the driers the commercial propane is run to storage.

Since Fullerton field gas is high in mercaptan content, it has been found practical to employ a regenerative caustic wash system ahead of the de-butanizer. This pretreatment reduces the mercaptan content to such an extent that butane requires no further treatment, and the remaining mercaptan sulfur in the gasoline is readily converted to odorless and noncorrosive disulfides in the copper chloride treater.

The depropanizer bottoms, after heat exchanging with the de-ethanizer feed, are further cooled with water to 95° F. The stream then flows through a perforated plate column countercurrently to a 10 percent sodium hydroxide solu-

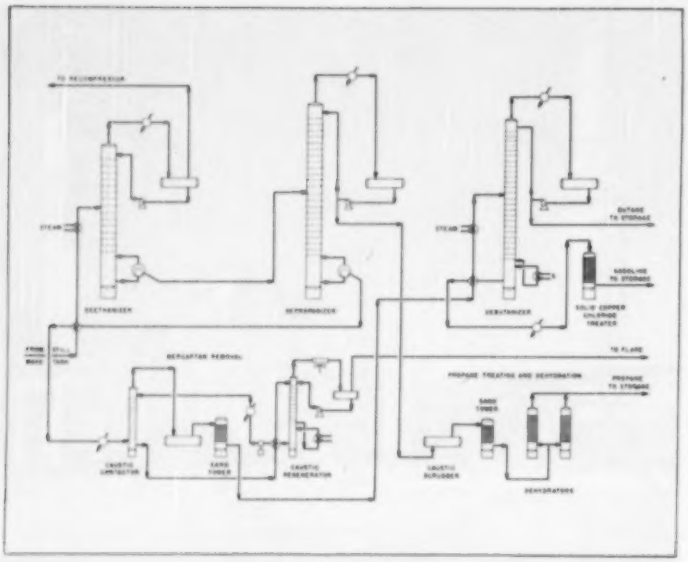


Figure 2. Fractionation and Product Treating.

tion, which is circulated at a design rate of 20 gpm. Spent caustic from the bottom of the contactor is regenerated in a small bubble tower utilizing stripping steam and a trap-out reboiler. The overhead vapors, consisting of mercaptan and steam, are sent to the flare.

The depropanizer bottoms flow from the contactor through a sand filter for removal of entrained caustic solution before entering the debutanizer. Butane is taken overhead and goes directly to storage. The gasoline, after being cooled, flows through the solid copper chloride treater to storage.

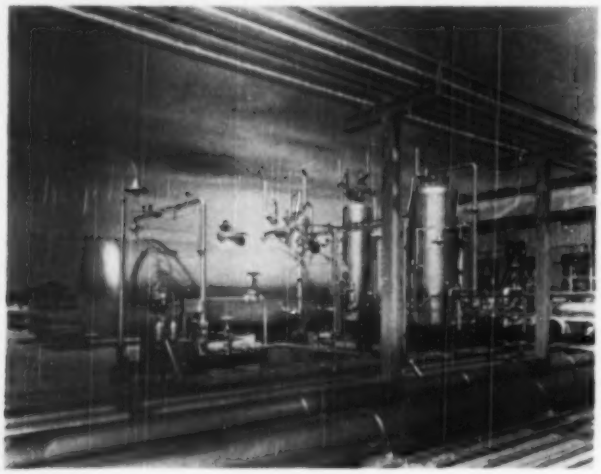
The de-ethanizer and depropanizer employ kettle-type reboilers utilizing 40 psig. exhaust steam. The debutanizer employs a thermo-siphon reboiler utilizing 100 psig. exhaust steam.

A product delivery line was constructed to the nearest railroad, primarily for the delivery of propane and butane since most of the gasoline and some butane move from the plant via crude oil pipe line. Five 1375-barrel horizontal tanks for propane, and three for butane, are located at the loading site. A 15-car doublespot railroad loading rack is provided.

At the plant site, there are three 2500-barrel spherical gasoline tanks, four 1375-barrel horizontal butane tanks, and six 1375-barrel horizontal propane tanks. Truck loading facilities are provided for propane and butane.

Other storage includes two 5000-barrel tanks for raw water, a 50-barrel domestic water tank, a 250-barrel lube oil tank, a 250-barrel crude oil tank, and a 500-barrel absorption oil tank, and storage for caustic and acid.

Operator reads pressure gauge on compression gasoline tank at the South Fullerton Gasoline Plant, operated by Stanolind Oil and Gas Company for the group of 14 owners. The plant is located in Andrews County, 17 miles northwest of Andrews, Texas. Casinghead gas from the South Fullerton field is being processed in the plant for the propane, butane, and natural gas content.



Utilities

The utilization of air coolers wherever practical helps to keep water requirements to a minimum. The two-still system, and the elimination of a reabsorber also aid in this respect by keeping steam requirements to a minimum.

The induced draft cooling tower is designed to cool 15,000 gpm. of water from 98 to 80° F. with a 71° F. wet-bulb temperature. Water is supplied by three water wells about thirteen miles from the plant. These wells are capable of delivering approximately 900 gpm.

Electric power is supplied by three 500-kw., 480-volt, 3-phase, 60-cycle electric generator units. Each generator is driven by an eight-cylinder, four-cycle gas engine.

The plant has three water tube boilers, each rated at 40,000 pounds per hour. Normally, all three boilers are fired, although two boilers are capable of handling the plant load. Steam is generated at 400 psig. and 700° F. Part of the steam is de-superheated by introducing condensate and goes to a 250-psig. system. The 400-psig. steam is used for all turbines and the 250-psig. steam is primarily used for reciprocating pumps and for primary still stripping steam. The evaporator and the turbines driving the lean oil pumps exhaust into a 100-psig. system. The 100-psig. steam is used for steam stripping in the secondary stripper and for the debutanizer reboiler. A 40-psig. exhaust steam system supplies other processing requirements.

* * *

Left, above—Control of a typical container fire with efficient methods and equipment is being demonstrated here by a safety expert of Socony-Vacuum Oil Company, Inc., on the training grounds at the company's refinery at Paulsboro, N. J.

Right, above—Fifty safety engineers from refineries in the U. S., South America and Europe saw this typical fire on steel steps—presumably caused by spilled or leaking gasoline—extinguished in a matter of seconds with modern methods and equipment.

Fire Control Helps Establish Outstanding Safety Record

HENRY OZANNE, Eastern District Editor

SOCONY-VACUUM Oil Company's fire prevention and control program, one of the most successful in all American industry, was explained in a two-day demonstration recently to safety engineers from the United States, Europe and South America. The demonstration was conducted at the company's Paulsboro, N. J., refinery which has been ranked as the safest among the 13 largest refineries of the world.

Socony-Vacuum's eastern marketing region, with an investment of millions of dollars in tanks, terminaling facilities and other installations, had only four small fires during 1949 for a total loss of $2400. None of the four fires was related to oil. The company reports it has not had a tank fire in 17 years. Its established fire-loss ratio in 1949 was .003, while for American industry generally average losses by fire over the last 15 years have amounted to 27 cents per $100 of insurable valuation, according to the National Board of Fire Underwriters. The comparable figure for the whole oil industry alone is 10.9 cents per $100 of insurable valuation.

The demonstration illustrated techniques of controlling and preventing petroleum fires and an extensive range of equipment and materials used in the safety program. The company's demonstration emphasized that three basic conditions must exist for an oil fire: there must be fuel in vapor form, fuel vapors must be mixed with correct proportions of air or other source of oxygen, there must be a source of sufficient heat to ignite the flammable air mixture.

Out of every 11 fatalities in which petroleum or petroleum products figure, 9½ occur outside the petroleum industry. That is, improper use of gasoline or other products in homes and in industrial operations is far more dangerous than operations within a refinery or other phase of the industry.

Socony-Vacuum's safety program against fires is headed by J. L. Risinger, who has been active in fire prevention programs for 27 years. He has served on all API safety committees, as a director of the National Safety Council, and with the Army, Navy and in civilian defense work during the last war. He cited his company's record in these words:

"With more than 2000 storage tanks of various sizes in more than 200 bulk plants and other installations in its eastern marketing division—tanks with a total capacity of 588 million gallons of gasoline, kerosine, fuel oil and similar products—not a single fire has originated in any of the tanks during the last 17 years."

The safety record of the petroleum industry is perhaps the most enviable of any industry. In the last 15 years, and

Despite the size of this typical fire in a pit of blazing fuel oil, the fire was extinguished with efficient methods and equipment in a matter of seconds by two fire-control experts of Socony-Vacuum's at the recent Paulsboro demonstration.

in the largest 124 refineries of this country, only two fires originating in refineries caused damage outside the refineries. On the other hand, 17 of the fires originated outside the refineries and spread into them. In the same period, an average of 11,700 tank trucks operated each year with only 22 occasions in which tank-truck fires caused damage to privately-owned property.

"Further," said Risinger, "in a total of 562,014 years of operation by the country's service stations during this same 15-year period, only 22 fires spread outside a service station. To put it another way, any given service station is likely to have a fire only once in every 187 years."

Below—A typical overhead fire—presumably a leak in a pressure line—was controlled quickly with new procedures and equipment.

Below—Fire-fighting experts teamwork and use of fog to cool and protect themselves, by quickly extinguishing this container fire.

Bending Moments and Leakage At Flanged Joints

PART III

ROBERT G. BLICK
Box 232, Sun Valley, Calif.

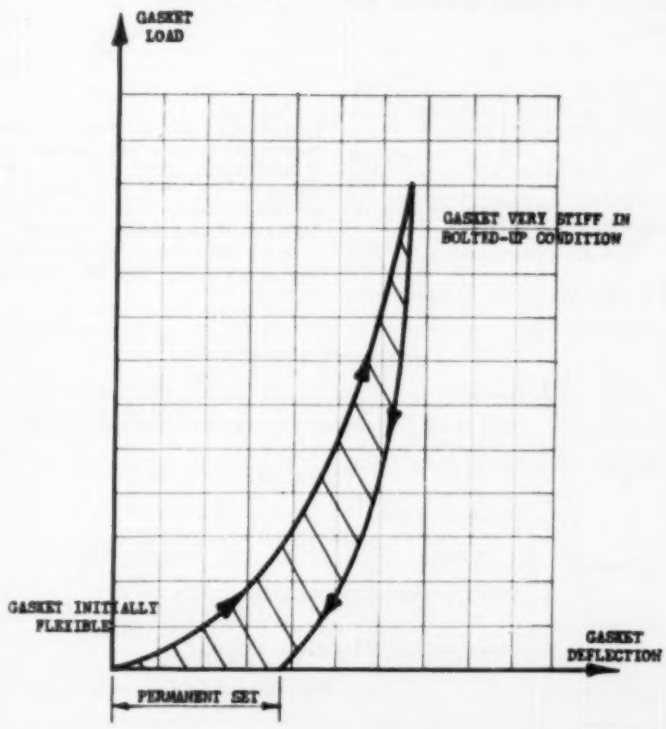
IN PART II of this series, mathematical relationships for joint-tightness were derived that assume a constant bolt-load. Also, the idea of a "leakage envelope," plotting performance capabilities of the joint, was determined. This concluding article discusses several other factors and derives the mathematics necessary to evaluate the effect of the dynamically changing bolt-load.

UP TO this point, it has been assumed that the "neutral" axis of the gasket coincides with the centroidal axis. This is not necessarily so. However, it is a logical assumption, and probably a correct one for all practical purposes.

Figure 10 is a qualitative representation of the stress-strain characteristics of compressed asbestos. It shows what happens when a load is gradually applied to and released from the gasket. Arrows on the curve indicate the direction of the cycle, from initial application of pressure to some final value, and then reduction of pressure to zero.

The return-path has a greater slope than the increase-path—that is, the gasket is "stiffer" under a decreasing load than under an increasing load. This can be deduced from purely theoretical considerations. Assuming that the gasket will take a permanent set, there will be a positive amount of work done in the total compression cycle. The shaded area in the figure represents the net loss of energy for a complete cycle.[1] That there must be a net loss for any portion of the cycle can also be deduced — for otherwise it would be possible to operate over a portion of the cycle and obtain perpetual motion.

Figure 10. Load-Deflection Curve for Compressed Asbestor



Since gaskets are stiffer under reducing load, there will be a shift of the "neutral" axis toward the "tension" side of the centroid. Figure 11 shows an exaggerated picture of this behavior. Actually, the shift of the "neutral" axis will probably be extremely slight—so that calculations may be made on the assumption that it coincides with the centroidal axis.

Some investigators may care to run load-deflection tests on practical gasket material. The load can first be run-up to the initial bolt-load value, and then reduced to the operating value (that obtains when the joint is under pressure). Then the load can be reduced to the value corresponding to *(mp)* in one test, and increased an equivalent amount (or to a load corresponding to the gasket "crushing" load) in another test. These tests can be repeated for a number of cycles. From the resulting curves the relative stiffness of the gasket under increasing and decreasing loads may be determined. The shift of the neutral axis can be computed from this data.

Similar load-deflection tests may be made for the flange and bolt combination without a gasket, or the flange rotations and bolt deflections may be computed. The resulting curves may be compared with the gasket curves. In this way, it can readily be determined whether the gasket really is appreciably stiffer than the bolt and flanges combination, and whether the basic simplifying assumption is a valid one.

Corrections for Change in Bolt-Load

The logical starting point for correction of the leakage envelopes for change in bolt-load is to determine whether the bolt-load decreases or increases after pressure is applied. Conclusions may then be reached regard-

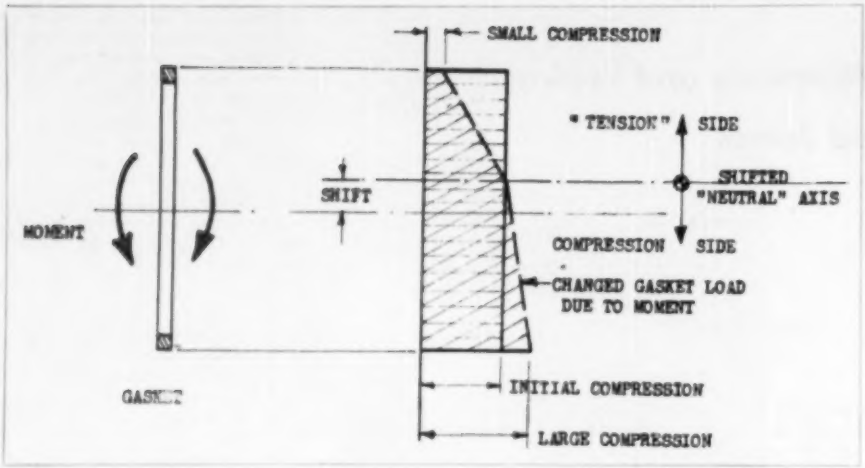


Figure 11. Shift of "Neutral" Axis

ing its behavior when moment is applied. If the bolt-load *decreases*, it means that the joint will start to leak, and the gasket to crush, sooner (at a smaller moment). The converse will be true if there is an *increase* in bolt-load.[2] The simplest, and probably an effective, correction may be made by altering the value of $A_B S_{ op}$ in the criteria formulas.

Actually, $A_B S_{ op}$ will be a function of the pressure and of the moment, rather than a constant. To illustrate this further, assume that the bolt-load will decrease as internal pressure is applied. Then the value of $A_B S_{ op}$ will decrease as pressure is applied. The maximum pressure capacity of the joint with no moment will be smaller than figures based on the initial bolt-load would imply. Assuming the joint to be under some intermediate pressure, and moment to be applied, the maximum value of the allowable moment would be smaller than formulas based on the initial bolt-load, or for bolt-load corrected for pressure only, would imply. This would be so for two reasons. On the "tension" side of the neutral axis, the bolt-load will be decreasing. This will tend to open up the joint sooner. On the compression side of the neutral axis, the bolt-load will be increasing.[3] This will tend to crush the gasket sooner.

Assuming that the no-pressure, no-moment bolt-load is $(A_B S_{ op})_o$, and that when internal pressure is applied, $1/K$ of the hydraulic end load is "picked up" as a *decrease* in bolt-load, then the bolt-load at a pressure p (with no moment) will be approximately

$$(A_B S_{ op})_p = (A_B S_{ op})_o - \frac{1}{K} \; p \; \frac{\pi G^2}{4}$$

Assuming that this same ratio $\left(\frac{1}{K}\right)$ holds for the effect of moment on the tension and compression sides of the neutral axis, then the adjusted bolt-load on the tension side (with no pressure) will be approximately

$$(A_B S_{ op})_{M1} = (A_B S_{ op})_o - \frac{1}{K}$$

(force due to moment)

If the "force due to moment" is taken as the summation of the gasket stress due to moment, and a triangular distribution is assumed, this force will equal

$$F_M = \frac{M}{\pi G/4}$$

so that the bolt-load corrected for amount on the "tension" side of the neutral axis may be taken as

$$(A_B S_{ op})_{M1} = (A_B S_{ op})_o - \frac{1}{K}\left[\frac{4M}{\pi G}\right]$$

and on the compression side may be taken as

$$(A_B S_{ op})_{M2} = (A_B S_{ op})_o + \frac{1}{K}\left[\frac{4M}{\pi G}\right]$$

The bolt-load on the "tension" side, corrected for both pressure and moment can then be called

$$(A_B S_{ op})_{pM1} = (A_B S_{ op})_o - \frac{1}{K} \; p \; \frac{\pi G^2}{4} - \frac{1}{K}\left[\frac{4M}{\pi G}\right]$$

and this value used in formula (6), which will become

$$M \leqslant \frac{G/4\,(A_B S_{ op})_o - p\,\frac{\pi G^2}{2}\left(\frac{G}{8} + bm\right)}{1 + \frac{1}{K\pi}} - \frac{p\,\frac{\pi G^3}{16K}}{1 + \frac{1}{K\pi}} \qquad (10)$$

Formula (10) then expresses the maximum moment not to have leakage due to insufficient gasket pressure, corrected for the effect of a change in bolt-load, assuming that the bolt-load decreases[4] when pressure is applied.

In the same manner as the foregoing, formula (7) may be reworked to read

NOMENCLATURE

$\frac{1}{K}$	Coefficient used to multiply the hydraulic end load to obtain the change in bolt load [assumed to decrease in formulas (10) and (11)]
Δ_B	Change in bolt length } Typical
Δ_{FB}	Change in bolt force } Typical
Δ_M	Change in moment
E_B	Elastic constant of half the bolt length $= \#/" \approx$ Total Bolt Area × "E" / Grip Length /2
E_G	Elastic constant of half the gasket thickness $= \#/" \approx$ Gasket Contact Area × "E" / Gasket Thickness /2
E_F	Elastic constant of the flange $=$ "#/Radian $=$ Total Bolt Load × Lever Arm / Resulting Angular Rotation in Radians

$$M < \frac{p\frac{\pi G^2}{16} + \frac{\pi G^2 y n}{2} - \frac{G}{4}(A_B S_w)_c}{1 + \frac{1}{K\pi}} + \frac{\frac{p\pi G^2}{16K}}{1 + \frac{1}{K\pi}} \qquad (11)$$

Formula (11) then expresses the maximum moment not to have crushing of the gasket, corrected for the effect of a change in bolt-load, assuming that the bolt-load decreases* when pressure is applied.

Evaluation of the Change in Bolt-Load Factor

$\frac{1}{K}$ has been conveniently defined so as to permit a simple correction for change in bolt-load. Off hand it may appear difficult to evaluate. However, this may be done without too much labor.

Figure 12 shows a segment of the flange with loads applied at the gasket, bolt circle, and mean diameter of the pipe. Intitially, it is assumed that the flange has been bolted-up to some initial bolt-load, the bolts have extended somewhat, the gasket has compressed somewhat, the flange has rotated through some angle, and that the value of Δ_{Fc} is zero. This is the condition represented by the solid-lined figure. The dashed outline shows the new picture when the load Δ_{Fc} is given some finite value. Δ_G is (half) the change in thickness of the gasket (assuming that the center of the gasket does not move). $\Delta\phi$ is the change in rotation of the flange.

Inspection of the geometry of the figure will yield the following results:

$\Delta_B = L_1 \Delta\phi - \Delta_G$ = half the change in length of bolts

Δ_{FB} = change in bolt-load
$= E_B \Delta_B$ (12)
$= E_B (L_1 \Delta\phi - \Delta_G)$

where E_B = stiffness of the bolts = pounds per inch deflection
Sign convention assumes bolt load decreases when answer is positive.

Δ_{FG} = change in gasket load
$= E_G \Delta_G$

where E_G = stiffness of gasket = pounds per inch deflection
Sign convention assumes gasket load decreases when answer is positive.

Δ_M = change in internal flange resisting moment
$= E_F \Delta\phi$

where E_F = rotational stiffness of flange = inch pounds per radian
Sign convention assumes moment increases when answer is positive.

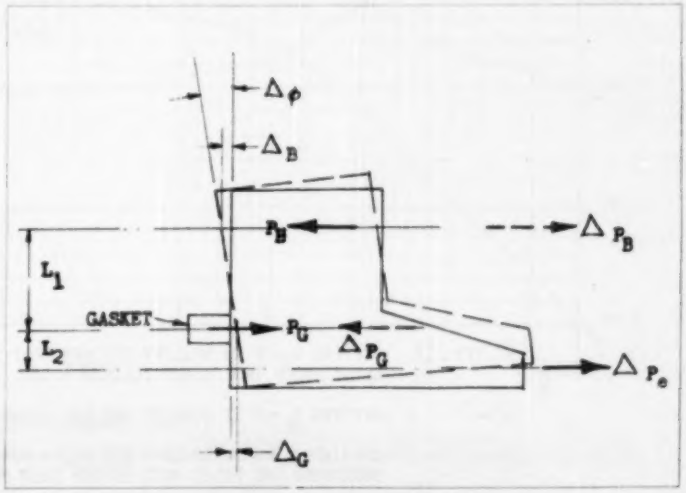


Figure 12. Loads on Flange Segment

The following equilibrium equations may be written:

$\sum \Delta_F = \Delta_{Fe} + \Delta_{FB} - \Delta_{FG} = 0$
(Summation of forces)

$\Delta_{FG} L_2 - \Delta_{FB} (L_1 + L_2) = \Delta_M$
(evaluation of change in flange moment)

These equations may be rewritten as:

$$\Delta_{Fe} + E_B (L_1 \Delta\phi - \Delta_G) - E_G \Delta_G = 0$$
or $$\Delta_G (-E_B - E_G) + \Delta\phi L_1 E_B = -\Delta_{Fe} \qquad (13)$$

and $$E_G \Delta_G L_2 - E_B (L_1 \Delta\phi - \Delta_G)(L_1 + L_2) = E_F \Delta$$
or $$\Delta_G [E_G L_2 + E_B (L_1 + L_2)] + \Delta\phi [-E_B L_1 (L_1 + L_2) - E_F] = 0 \qquad (14)$$

Equations (13) and (14) may be solved simultaneously to yield the following results:

$$\Delta_G = \Delta_{Fe} \frac{[E_B L_1 (L_1 + L_2) + E_F]}{[E_F (E_B + E_G) + E_B E_G L_1^2]} \qquad (15)$$

$$\Delta\phi = \Delta_{Fe} \frac{[E_G L_2 + E_B (L_1 + L_2)]}{[E_F (E_B + E_G) + E_B E_G L_1^2]} \qquad (16)$$

and, since $\Delta_B = L_1 \Delta\phi - \Delta_G$:

$$\Delta_B = \Delta_{Fe} \frac{[E_G L_1 L_2 - E_F]}{[E_F (E_B + E_G) + E_B E_G L_1^2]} \qquad (17)$$

By substituting equation (17) in equation (12), it can be determined that:

$$\frac{1}{K} = \frac{E_B [E_G L_1 L_2 - E_F]}{[E_F (E_B + E_G) + E_B E_G L_1^2]} \qquad (18)$$

That value of $\frac{1}{K}$ may then be used in formulas (10) and (11). Inspection of the terms of equation (18) shows that $\frac{1}{K}$ may be either positive or negative (that the bolt-load may either decrease or increase) depending on the relative magnitudes of $(E_G L_1 L_2)$ and (E_F).

Comparison With Test Data

Reference No. 5 contains test data on the behavior of an experimental flange when internal pressure is applied. It will be informative to use formula (18) on this test flange, compute the bolt-load change after internal pressure is applied, and compare the computed value with the actual test figure. The data on flange C-1 of this reference is as shown in Table 1.

TABLE 1

Bolts	Gasket	Flange
28 at ¾" Dia.	2 at 1/16" thick	2½" thick
D_{BC} = 28 ⅝" (Bolt Circle)	Soft iron ¼" contact face ½"-total width	30 ⅝" O.D. 25" I.D. 5⅛" max. Hub thick
*$E_B = 92 \times 10^6$	G = 26 ¼" †$E_G = 4960 \times 10^6$ (Assuming E = 29 x 10^6, and discounting any other flexibilities)	7/16" pipe wall thick L_1 = .938" L_2 = .726" *$E_F = 86 \times 10^6$

* Computed from the data in reference.

† Heare question can be raised as to what constitutes the "gasket" in an assembly of this stiffness.

From this data, using formula (17),

$$\frac{1}{K} = \frac{10^{22}}{10^{27}} \times \frac{92\,[4960 \times .938 \times .726 - 86]}{86\,[92 + 4960] + 92 \times 4960 \times .938^2}$$

$$\frac{1}{K} = .362$$

When the internal pressure is 300 psi., the hydraulic end load Δ_{Fe} will be:

$\Delta_{Fe} = \pi/4\ G^2 p = \pi/4\ (26\ 7/8)^2 \times 300$
$= 170{,}000$ #

from the value of $\frac{1}{K}$ computed above, the change in bolt-load should be:

$\Delta_{FB} = \frac{1}{K} \Delta_{Fe}$
$= .362 \times 170{,}000$
$= 61{,}500$ pounds

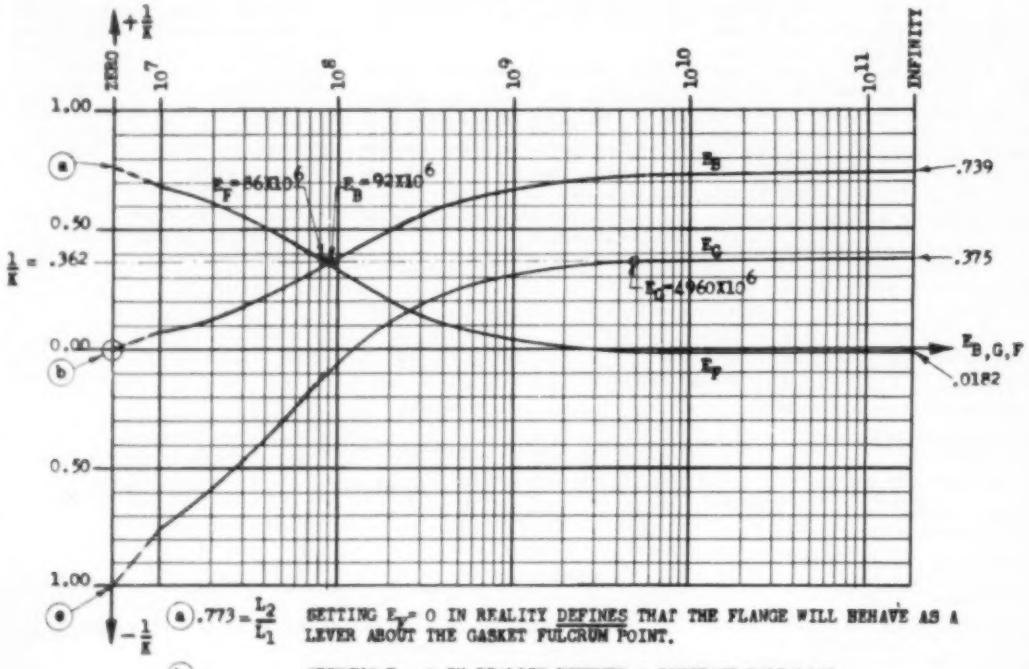
That is, the bolt-load should decrease by 61,500 lbs. By comparison, the test values ranged from 46,000 to 124,000—the mean value being 73,000 pounds. Assuming this mean value to be "correct," the discrepancy between the computation and the test is about 15 percent. In terms of the many factors that can contribute to this discrepancy, the agreement between the values is quite good. In terms of "safety-factors" generally employed and the small over-all effect on the leakage envelope, the discrepancy is probably negligible.

Figure 13 shows the effect on $\frac{1}{K}$ of varying each of the stiffness factors while holding the others constant. It will be seen that $\frac{1}{K}$ is not sensitive to changes in E_G, in the neighborhood of the operating value. That is, the gasket is behaving rather effectively as a fulcrum. On the other hand, it is somewhat sensitive to changes in E_F and E_B. Readers familiar with Reference No. 5 may note that the value of $\frac{1}{K}$ that would be required by the test data *increases* as the internal pressure is increased. This may in part be explained by decreasing "twisting stiffness" of the flange as flange moments are increased. The smaller flange stiffness-factor would then make for a greater value of $\frac{1}{K}$—and thus it can be seen that the results of the formulas agree with the trend of the test data.

Use of the Formulas

The general suggestion of this article is to use formulas (6) and (7) to construct leakage envelopes ignoring the influence of $\frac{1}{K}$. The formulas are easy to apply and should be of accuracy sufficient for practical design. Evaluation of the various stiffness factors, normally a somewhat complicated undertaking, is thereby avoided. It is possible for the formulas to be either somewhat conservative or somewhat unconservative. Figure 14 has been constructed to show the influence of $\frac{1}{K}$ on the leakage envelope. It has been made from formulas (10) and (11), for the 8-inch-150-pound flange of the previous example. $\frac{1}{K}$ is permitted to vary from +.50 to —.50. The shaded area in the figure defines the questionable zone. Inspection of the figure will show that even for this wide range of $\frac{1}{K}$ values, the results of formulas (6) and (7) are of good accuracy. Also, it can be demonstrated mathematically that the maximum positive value $\left(\frac{1}{K}\right)$ can have, for any combination of the various stiffness factors, is $\left(\frac{L_2}{L_1}\right)$. For this example, $\left(\frac{L_2}{L_1}\right)$ is .25; the boundary corresponding to that $\left(\frac{1}{K}\right)$ value lies within the lower part of the shaded area. Leakage envelopes constructed using formulas (10) and (11) with a positive $\left(\frac{1}{K}\right)$ value taken equal to $\left(\frac{L_2}{L_1}\right)$ will always be conservative. If formulas (6) and (7) place the moment-pressure condition well within the envelope, the problem is adequately solved. If the operating condition falls close to the extremes of the envelope, formulas (10) and (11) may be used with an assumed $\left(\frac{1}{K}\right)$ value not greater than $\left(\frac{L_2}{L_1}\right)$. As a last resort, the various stiffness factors may be calculated and

Figure 13



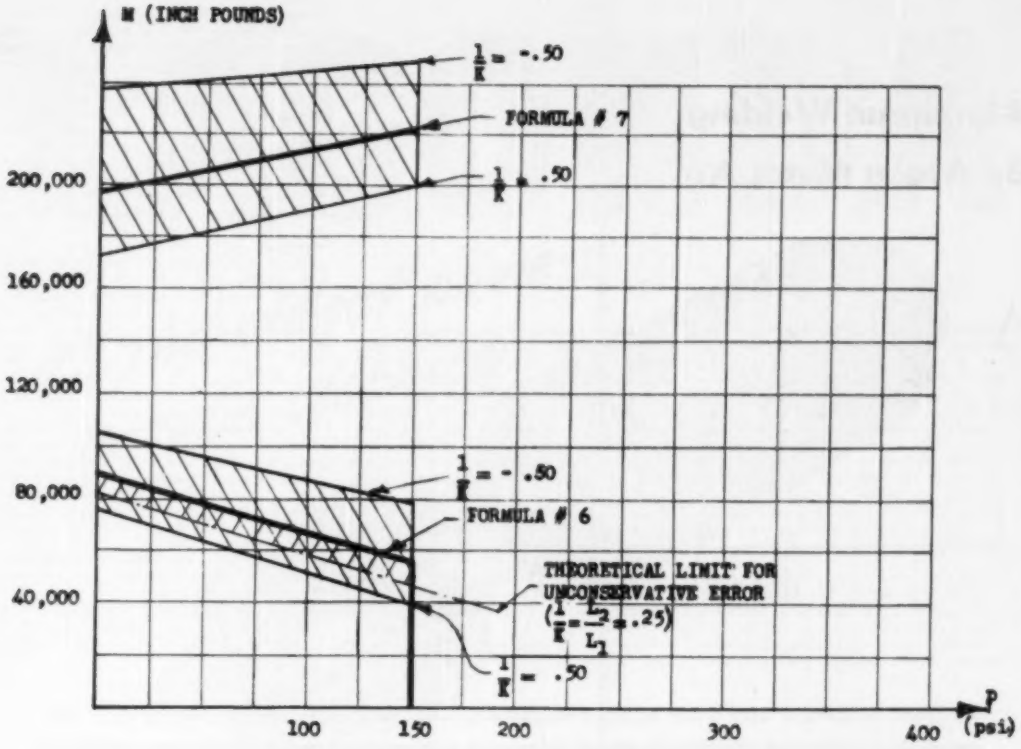


Figure 14. Influence of $\frac{1}{K}$ on Leakage Envelope

used to correctly evaluate $\left(\frac{1}{K}\right)$ then using that value in formulas (10) and (11). These latter formulas have been arranged so that the numerical computations of (6) and (7) are used, so that calculation labor is reduced.

General Conclusions

The writer hopes that the conclusions drawn in this article may stimulate further research, bring into publication any private test data that may be available, and point a direction for further experiment. Despite the fact that the methods of this article are rational, the problem is by no means completely solved. Additional data on the elastic and plastic characteristics of gasket material are needed. The torsional effect on the flange of the non-uniform flange-moments needs to be evaluated. And service life characteristics need correlation with static characteristics. These are but a few of the many avenues along which research must travel until the flanged joint has been thoroughly explored.

(End of Part III and series.)

NOTES AND REFERENCES

[1] The net loss will generally be smaller after several cycles.

[2] Some readers may note that the tendency of a **reduction** of bolt-load is to exaggerate the gasket stress-pattern under moment—that is, make it concave rather than triangular. The tendency of an **increase** in bolt-load, on the other hand, is to make the gasket stress-pattern convex (approaching a rectangular distribution). Probably an additional refinement of this nature would be misleading, fundamentally because practical analysis methods and data really disallow attempts to obtain such high accuracy.

[3] Since a "push" will have the negative effect of a "pull."

[4] By changing the sign of all terms involving $\frac{1}{K}$, the formula will read the value obtained if the bolt-load **increases.**

[5] D. B. Rossheim, E. H. Gebhardt, H. G. Oliver "Tests of Heat Exchanger Flanges"—Transactions of the ASME, 1938.

[6] The reader may rewrite the formulas to use "K" instead of $\left(\frac{1}{K}\right)$ which was used to avoid confusion with S. Labrow's factor.

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API-ASME Code for Unfired Pressure Vessels.

Steel Flanges ASA B16E.

ASA Code for Pressure Piping.

* * *

Aluminum Welding By Argon Metal Arc

ARGON metal arc welding of aluminum—an electric welding process in which the arc is maintained in a shield of argon gas between a filler metal electrode and the aluminum workpiece—has been developed commercially for all of the weldable aluminum alloys, including 2-S, 3-S, 52-S, and 61-S. Initial development of the process is being concentrated on machine use, although the process is applicable to either machine or hand welding. The electrode is supplied as a coil of aluminum wire which is deposited as filler metal across the arc into the weld.

Aluminum, ranging in thickness from ¼ inch to 1½ inches, has been welded by the process. Minimum practicable thickness for welding is about 3/16 inch. In welding heavy plate, the multi-pass technique makes possible the welding of practically unlimited thicknesses.

The process easily welds butt, fillet and lap joints. With the vee for fillet and lap welds in the flat position, higher deposition rates are possible and fewer passes are necessary. With the mechanized setup presently available, butt welding is limited to the flat position, and fillet and lap welding to the flat and horizontal positions. Application is most economical on fairly long joints. Some of the uses of the welding process are for railroad tank cars, chemical and food processing equipment, large storage tanks, and pressure vessels.

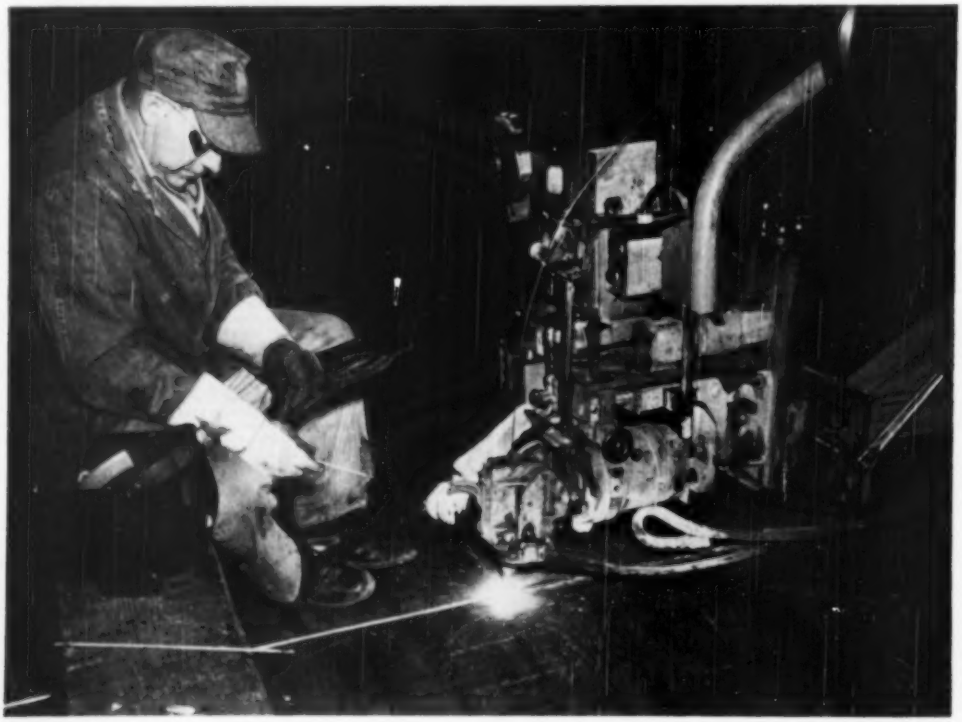
The use of argon to protect the weld zone provides certain major advantages for the process. One advantage is that no flux is required for welding of aluminum which eliminates the possibilities of flux corrosion or entrapment. Weld cleaning operations are eliminated and finishing costs reduced because no flux is required, which provides low operating cost for the process. The process provides a high quality weld having about the same physical and mechanical properties as with the Heliarc process. Tensile strength is higher in some applications because of less heat effect due to high welding speed. X-ray examination shows welds extremely dense and sound.

Depending upon the quality of the weld required, practical welding speeds with the argon process vary over a considerable range. Welds have been made as slow as 5 inches per minute in fairly heavy plate, and as fast as 48 inches per minute in ¼-inch structural members. Welding of structural members can be made at higher speed than those that must meet pressure-vessel specifications. Most significant of other factors that affect welding speeds is the joint design used. Accuracy of edge preparation and set up are also important.

The welding machine consists of an electrode feeding mechanism, a gas cup and guide-tube assembly, and a special voltage control. Argon and cooling water flow is controlled by solenoid-operated shutoff valves. A welding generator, of 600-amp. rating is required to supply direct current, reversed polarity for use with the argon process, to obtain the cleaning action essential for welding aluminum without flux.

Data and photograph courtesy of The Linde Air Products Company, a unit of Union Carbide and Carbon Corporation, New York.

Argon metal arc machine in use at General American Transportation Company welding aluminum car tanks of plate 1⅛ in. thick.



LAGONDA

it's the oldest name in tube cleaning

When the first tube still was erected, Lagonda cleaners were there to take on the cleaning job.

There are fifty constructive years behind the Lagonda cleaner of today. A full half century of development, with all the grief of adventuring up false roads, all the satisfaction of real improvement achieved, that accompany successful pioneering in any equipment. This half century of invaluable experience is today bringing in big dividends to refineries everywhere where — dividends in the form of faster, more thorough tube cleaning, delays eliminated, costly minutes and hours saved in getting stills back on stream.

Put this half century of know-how to work for you. When you have a tough problem, call in the Lagonda man. No obligation.

Here is the refinery tube cleaner that half a century of successful effort has brought forth —the famous LAGONDA 1100 SERIES, ball bearing front and rear handling thrust both ways fully lubricated in *all* bearings, and demonstrably capable of delivering coke-smashing power that only LAGONDA designed cutter heads can be expected to sustain.

Fully described in the LAGONDA bulletin, on request.

Y-297

ELLIOTT Company

LAGONDA DIVISION • SPRINGFIELD, OHIO

Plants at: JEANNETTE, PA. RIDGWAY, PA. • ASPERS, N. J. SPRINGFIELD, O. • NEWARK, N. J. DISTRICT OFFICES IN PRINCIPAL CITIES

MOORE NULLMATIC M/P CONTROL STATIONS and remote-set CONTROLLERS

Standard Equipment on GRAPHIC PANELS

Illustration, Actual Size

Uses the precision Nullmatic Regulator

The Nullmatic Controller provides force-balance, friction-free operation

Bumpless Manual-Automatic switching

Interested in Graphic Panels and Consoles?

Refinery Installations

Installation	Application	Graphic Panel Engineering
★★CONTINENTAL OIL CO. Denver, Colo.	TCC Cracking Unit 4,800 bbl./day	Lummus
★COSDEN PETROLEUM CORP. Big Spring, Texas	UOP Fluid cat. 6,000 bbl./day	UOP Panellit
★DEEP ROCK OIL CO. Cushing, Okla.	UOP Fluid cat. 5,000 bbl./day	UOP Panellit
★GLOBE OIL & REF. CO. Lemont, Ill.	UOP Fluid cat. 6,000 bbl./day	UOP Panellit
★INDIANA FARM BUREAU Evansville, Ind.	Complete refinery 5,000 bbl./day	UOP Panellit
★OLD DUTCH REFINING CO. Muskegon, Mich.	UOP Platformer 1,900 bbl./day	UOP Panellit
PAN AM SOUTHERN CORP. El Dorado, Ark.	Delayed coker 9,300 bbl./day	Lummus G E
★ROCK ISLAND REF. CO. Indianapolis, Ind.	Complete refinery 10,000 bbl./day	UOP Panellit
SHELL OIL CO. OF CANADA Montreal, Quebec	Solutizer 7,000 bbl./day	Shell Peacock
SOCIETE GENERALE Dunkirk, France	Dist. 26,000 bbl./day Lube 9,000 bbl./day	Lummus
STANDARD OIL CO. (OHIO) Lima, Ohio	Dist. 9,000 bbl./day Lube 3,500 bbl./day	Lummus G. E.-Sohio
SUN OIL CO. Toledo, Ohio	Houdriflow cat. 30,000 bbl./day	Sun-Houdry Panellit
★TIDEWATER ASSOC. OIL CO. Drumright, Okla.	Houdriflow 4,500 bbl./day	Panellit
★WOOD RIVER OIL & REF. CO. Hartford, Ill.	UOP Fluid cat. 7,500 bbl./day	UOP Panellit

★ = On Stream by May 5, 1950 ★★ = First on Stream

Over a thousand NULLMATIC M/P Stations—with remote-set NULLMATIC Controllers—are being used on the panels listed above, on graphic panels in five chemical plants, on consoles, and on conventional control boards.

MOORE PRODUCTS CO. PHILADELPHIA 24, PA. *Branches:* DETROIT, CHICAGO, HOUSTON, PITTSBURGH, LOS ANGELES

The MONTH...

in the INDUSTRY

SHORT COURSE AWARD—The silver anniversary meeting of the Southwestern Gas Measurement Short Course attracted many past and present members of the general committee who marvelled at the progress which has been made and the broad scope attained.

The 1950 Short Course marked another milestone in the life of W. H. Carson, dean of the College of Engineering, University of Oklahoma, Norman, who has been the directing force in the Short Course for the past 25 years. In appreciation of his services, all of the men who have served with Dean Carson throughout the years presented him with a plaque and a scroll. This group also presented to Dean Carson a deer rifle and a set of deluxe matched luggage. The presentation (above) was made by C. B. Day, general manager of Consolidated Gas Utilities Corporation, who served as general chairman of the Short Course in 1931.

WPRA Kansas Meeting Scheduled for June 23

Four speakers are scheduled to appear at the one-day regional meeting of Western Petroleum Refiners Association to be held in Wichita, Kan. June 23. Discussions will be on the technical aspects of refinery operations and industrial relations.

K. M. Brown, Universal Oil Products Company, Chicago, will describe a CO_2 caustic neutralizer recently developed by UOP, particularly for use in cat cracking plants. "Recent Advances in Industrial Psychology" will be given by Dr. Harry C. Mahan, consulting industrial psychologist and a faculty member of Wichita University. W. Edward Lemon, Tulsa, manager of the petroleum division of J. F. Pritchard & Company will discuss "Can a Storage-Stable Distillate Fuel Be Manufactured?" A discussion of job evaluation will be given by John M. Napier, member of the industrial relations staff at Boeing Aircraft Company.

Harry F. Sinclair To Retire Under Pension

Harry F. Sinclair has been given the title of honorary chairman of the board of Sinclair Oil Corporation upon his request to retire under the company pension plan. Sinclair, who asked not to be re-elected chairman, will continue as a director and consultant.

P. W. Thirtle, comptroller, was elected vice president, and H. Jeffries, formerly assistant, was promoted to comptroller.

Automotive-Petroleum Relations Topic of Meet

The close relationship between the automotive and petroleum industries will be discussed by leaders in both fields at a meeting of the Lubrication Committee of the American Petroleum Institute in the Book-Cadillac Hotel, Detroit, on June 14-15.

Speakers at a June 14 dinner session —Major General James H. Doolittle, vice president of Shell Oil Company, and George Romney, executive vice president of Nash-Kelvinator Corporation— will discuss "The Automobile and Petroleum Industries, Partners Before the Public."

Group sessions earlier in the day will have subjects and speakers as follows:

"Compression Ratio, Octane Demand, and Lubrication," R. S. J. Pigott, director, Engineering Division, Gulf Research and Development Corporation; "Engine Design and Its Relation to Fuels and Lubricants," Victor G. Raviolo, assistant to chief engineer in charge of engine development, Ford Motor Company; "Automatic Transmissions and Their Service," G. A. Round, chief automotive engineer, Socony-Vacuum Oil Company. Discussions will be by H. L. Moir, of The Pure Oil Company, and H. R. Wolf, of General Motors Corporation.

A business meeting of the committee, with subjects of interest to both the automotive and petroleum industries, will be held June 15.

Canada's 1949 Refined Products Output Up

Saleable products output of Canadian refineries increased 10.2 percent in 1949 over 1948, according to year-end figures issued by the Dominion Bureau of Statistics, Department of Trade and Commerce.

The report also gives year-end figures for 1949 compared with 1948 on crude receipts by refineries, the breakdown showing a slight decrease in the amount of imports with nearly doubled receipts of domestic crude.

Total net production of saleable products (barrels of 35 Imperial gallons) was approximately 89.3 million in 1949 and 81 million for 1948.

First Outside Member Elected to Socony Board

Dr. Grayson L. Kirk, provost of Columbia University, has been named as the first outside member of the board of directors of Socony-Vacuum Oil Company, Inc. The other ten members of the board are full time employes.

One of the nation's leading authorities in government and international relations, Dr. Kirk has been a member of the Columbia faculty of political science since 1940 and holds the rank of professor of international relations. Dr. Kirk was recently named a vice president of Columbia and will assume office July 1 as principal assistant to President Dwight D. Eisenhower.

Scientific Plant Location Urged for Process Growth

Haphazard methods used in the past for locating new processing plants would be dangerous to the healthy growth of the process industries, according to Professor Donald F. Othmer, head of the department of chemical engineering at Polytechnic Institute of Brooklyn, and Robert S. Aries, president of R. S. Aries & Associates, Brooklyn. Processing industries in the U. S. will continue to grow at the rate of about $2½ billion per year during the 1950's, they estimated, which matches the recent tremendous growth per year from 1930 through 1949.

The processing industries have not migrated, but have grown during the last eight years in different areas at different rates, they claimed. Development of the processing industries in the Southwest (Texas) has not caused any dislocation in the process industries in other parts of the country, according to Othmer and Aries, as the East is still the seat of most of the processing industries on a proportional basis with losses to other areas insignificant.

Employe Benefits Extended By Revised Conoco Plan

A minimum retirement payment of $125 a month has been included in a liberalized employe benefit plan adopted by Continental Oil Company. This amount includes revised federal old age benefits and will be paid to men retiring at age 65 and women at age 60 who have at least 20 years' service. One of the provisions is a separation retirement allowance or "vested right" under which employes leaving after 10 years' service will be entitled to a deferred retirement payment (at age 65 for men and 60 for women), provided they have not withdrawn their own contributions from fund. Employes get credit for portion of company contributions after 10 years, this portion increasing from 25 percent at end of 10 years to 100 percent at end of 20 years, without regard for age.

Cities Service Wins In First Aid Contest

Top honors went last month to a seven-man team from Cities Service Refining Corporation's butadiene plant at Lake Charles, La. which together with

The MONTH...

three other company teams competed in a first aid contest held at the industrial exposition, Houston. In second place was Mathieson Chemical Corporation. Other trophies awarded for the artificial respiration problem were given by the emergency corps and the exposition to three tying groups—Cities Service, Mathieson Chemical, and the emergency corps. Southern Alkali Corporation, Lake Charles, La. also participated. Rules and regulations of the contest were governed by the Bureau of Mines first aid manual, with teams working four problems each.

Team members are as follows:

Cities Service—George Baumann, captain, Leroy Stephens, Richard Prater, Austin Miller, Forrest Derouen, M. W. Ingles, and Wm. Brown.

Southern Alkali—James F. Buckner, captain, Ralph Cooksey, Homer Newsome, Thomas E. Powell, Howard Bushnell, Harry Brooks, and Albert C. Griffin.

Mathieson Chemical—J. C. Moreau, captain, Douglas L. Taylor, J. A. Mims, D. A. Wilkins, A. L. Hollingshead, W. A. Nelson, and G. H. Thornton.

Harris County Emergency Corps—J. W. Johnson, captain, H. E. Scherffius, M. S. Jezierski, R. J. Templet, Perry Noessel, and Jack Seiffler.

IPAA Sees Oil Demand Up 5.7 Percent for 1950

The Independent Petroleum Association of America estimated that a new oil supply required to meet a 5.7 percent higher total U. S. demand for all oils in 1950, after stock changes, must average 6.42 million barrels per day and that this figure would rise to 6.63 million barrels per day in the first quarter of 1951.

While attempting no breakdown between domestic production and imports, the association reported also that if imports plus U. S. output of natural gasoline and allied products continued at their first quarter 1950 levels, this year's demand for domestic crude in barrels per day would average 5.13 barrels per day as compared with actual production averaging 5 million barrels per day in 1949 and 5.5 in 1948.

Trends of Operations and Changes in Stocks

Figures on crude stocks are from Bureau of Mines weekly reports; all others from American Petroleum Institute weekly reports, which are estimates on Bureau of Mines basis.

(All figures in thousands of barrels—add 000)

Trends in Week Ended	Crude Oil			Gasoline		Gasoil and Distillate		Residual Fuel	
	Production Daily	Runs to Stills Daily	Stocks Week End	Production Weekly	Stocks Week End	Production Weekly	Stocks Week End	Production Weekly	Stocks Week End
1949:									
January 29	5,493	5,490	255,459	17,531	114,677	7,547	63,142	8,178	63,333
February 26	5,401	5,412	261,965	17,621	124,382	7,430	54,008	8,225	59,348
March 26	5,188	5,353	266,506	17,417	128,087	6,167	48,721	8,305	58,792
April 30	4,980	5,273	271,255	17,969	124,787	6,681	49,959	8,185	60,174
May 28	4,951	5,297	275,190	18,378	120,661	5,943	55,971	8,144	63,758
June 25	4,944	5,322	274,114	18,462	115,715	5,148	63,049	7,856	66,166
July 30	4,731	5,187	271,999	18,058	109,964	6,293	70,767	7,205	67,166
August 27	4,769	5,215	266,455	18,180	106,280	6,491	74,718	7,597	68,394
September 24	4,933	5,377	259,186	18,152	103,262	6,555	81,414	7,419	68,143
October 29	5,075	5,509	252,069	19,002	103,915	7,016	90,358	7,734	69,459
November 26	5,192	5,331	256,409	18,204	104,917	6,971	91,795	8,188	67,087
December 24	4,955	5,482	256,850	18,045	110,104	7,335	78,662	8,046	61,647
1950:									
January 28	4,956	5,470	248,411	18,363	124,270	7,302	60,337	8,360	57,088
February 25	5,000	5,277	245,586	17,705	133,888	6,890	56,050	7,955	48,963
March 25	4,948	5,460	244,227	17,939	135,406	6,870	40,577	8,171	42,540
April 29	5,014	5,314	244,744	18,038	128,685	6,831	30,986	7,272	39,260
May 27	5,118	5,591	240,842	18,704	122,757	7,201	40,607	7,421	39,308

Texas Council to Study Declining Tax Revenues

An Industry Advisory Committee, composed of representative persons from each segment of the petroleum industry, has been appointed by Governor Allen Shivers of Texas, acting under Senate Resolution No. 65, to furnish technical information in an advisory capacity only to the Texas Legislative Council. The Council has been requested to make inquiry into the basic and underlying causes for the steadily declining tax revenues to the state from the petroleum industry and injury to the state's economy and to subsequently determine the causes and recommend remedies. These recommendations of the committee and Council are to be submitted to the regular session of the 52nd Legislature of Texas for its consideration.

Members of the committee, of which Dan W. Hovey, Houston, is chairman, are to serve on a voluntary basis without expense of any kind to the state, according to the resolution. Included are E. O. Bennett, Houston; H. E. Childs, Midland; Harold Dunn, Amarillo; Dr. R. J. Gonzalez, Houston; Ray Hubbard, Dallas; Sidney Latham, Dallas; Harry Leyendecker, Houston; John Lynch, Corpus Christi; Glenn McCarthy, Houston; Raymond M. Myers, Dallas; Sid W. Richardson, Fort Worth; Pat R. Rutherford, Houston; Fred Shield, San Antonio; Clay Underwood, Wichita Falls; and John Wrather, Longview.

Refining Co-ordinator Will Head Esso Export

William J. Haley, co-ordinator of refining operations of Standard Oil Company (New Jersey), has been elected president of Esso Export Corporation. He succeeds Frank M. Balling who will remain a director pending his retirement in the near future. With Haley named a director, Esso Export's board numbers nine.

Harold W. Fisher, deputy co-ordinator of Jersey Standard, was appointed to succeed Haley as head of the refining co-ordination department.

Gets Socony $2000 Grant

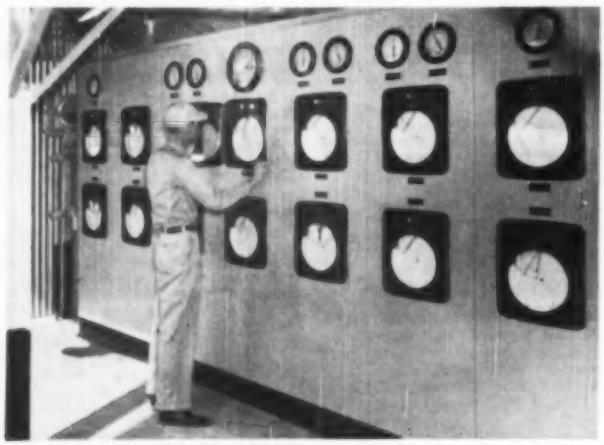
Socony-Vacuum Oil Company, Inc., has awarded $2000 to the University of Michigan, Ann Arbor, for renewal of a fellowship in chemical engineering during the year from September 1 to August 31, 1951. A total of 20 such grants will be supported by Socony-Vacuum during the 1950-51 academic season at colleges and universities throughout the country at a total expenditure of $40,000. They represent 19 renewals and one new fellowship.

Maritime Refinery Resumed

Maritime Oil Company has resumed operations at its 5000-barrel-per-day Houston refinery, running approximately 2500 barrels per day of crude. The company, one of several Texas and Louisiana Gulf Coast Independents who curtailed operations or shut down several months ago, will produce gasoline, burning oils and heavy fuel. No kerosene will be produced at the beginning.

Phillips Chemical Award

The Plains butadiene plant, operated by Phillips Chemical Company, near Borger, Texas, has received the National Safety Council award of honor for distinguished service to safety, the plant having worked 3,001,629 man-hours in



FULLERTON COMPLETED—Instrument controlman checking instruments on the control panel in the process area of the gasoline plant formally opened last month in the South Fullerton field, Andrews County, Texas. Stanolind Oil & Gas Company is the operator for a group of 14 owners. The panel is one of three of this type in the plant.

(See complete story commencing on page 123.)

ALOYCO introduces *RADICALLY NEW* Needle Valve and Plug Gate Valve

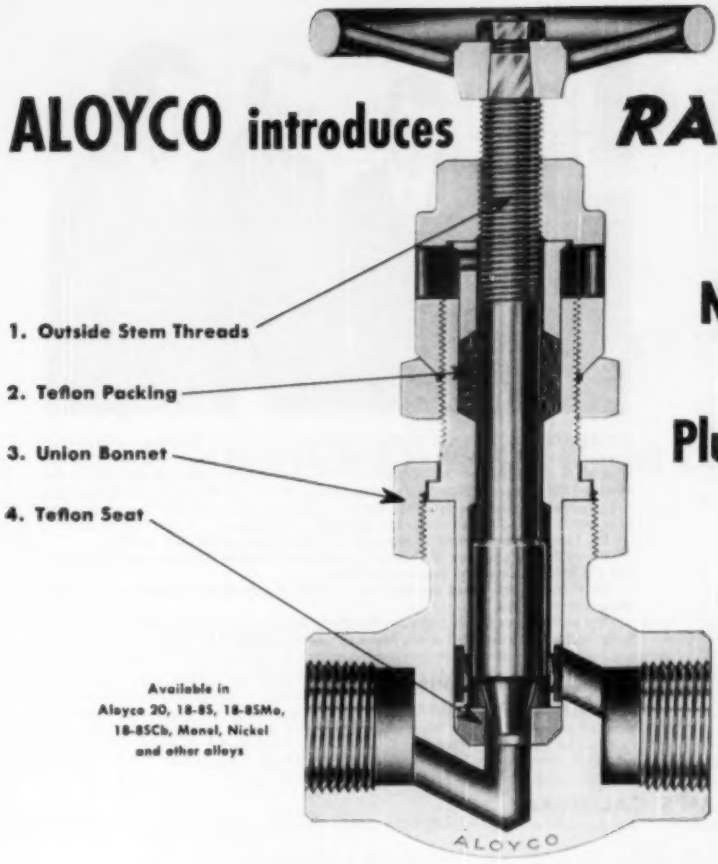


FIGURE NO. 62½ NEEDLE VALVE
Needle Point Globe Type
Sizes ¼" through 1". 3000 lbs. W.P.

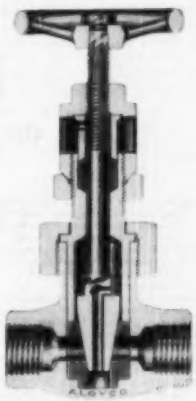


FIGURE NO. 66½ PLUG GATE VALVE
Straight-Through Type
Sizes ⅛" through ½". 3000 lbs. W.P.

These *really new* ALOYCO Teflon-seated forged body valves eliminate the operating difficulties found in *ordinary* bar stock valves because:

1. Outside Stem Threads, rather than inside screw, prevent corroding and sticking of stems.

2. Teflon Packing, rather than ordinary types, stops stuffing box leakage.

3. Union Bonnets, instead of screwed-in type, add strength and safety.

4. Teflon Renewable Seats, instead of metal-to-metal, eliminate galling and seizing—insure pressure tightness.

Nothing has been spared to obtain maximum mechanical efficiency, as well as corrosion-resistance in these valves. Write or telephone our nearest branch for Technical Information Bulletin No. 5.

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Title _____

Company _____

Street _____

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The MONTH...

approximately 800 days without a lost-time injury.

O. D. Henderson is safety director of the plains plant assisted by L. D. Baker.

Whiting Foreman Retires

Albert M. Schaefer, a night foreman at the Whiting, Ind., refinery of Standard Oil Company (Indiana), this month celebrates 50 years of service with the company which were begun in the barrel house office when he was 14 years old. All of Schaefer's record has been with the heavy oils division of the Whiting refinery where he has also been filtering oils department compounder.

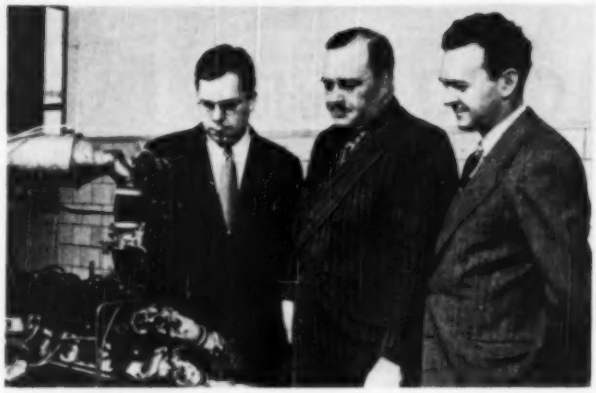
Schaefer, retiring June 26 on company annuity, was given a gold watch.

Buys Asphalt Firm

Producers Refining, Inc., of West Branch, Mich., has purchased Asphalt Products Company in that city and will operate the plant as its asphalt division without change in management.

Great Britain Ends Gasoline Rationing

Standard Oil Company of New Jersey and The California Texas Oil Company have agreed to bring to England additional gasoline supplies and accept payment in pounds sterling. The British government's decision to end rationing of gasoline followed the Jersey Standard agreement. Both companies have agreed to spend this sterling on goods and services in their operations in the sterling area or on building tankers in Britain.



TECHNOLOGISTS TO NEW POST—Appointment of C. O. Tongberg as associate director and J. G. McNab and C. L. Fleming as assistant directors of the Research Division of the Standard Oil Development Company, central research affiliate of the Standard Oil Company (New Jersey), was announced last month. Dr. Tongberg succeeds S. C. Fulton who becomes associate director of the Chemical Division in a reallocation of research responsibilities within the development company.

Dr. Tongberg, a graduate of Harvard and Penn State, joined SOD in 1937.

Dr. McNab, a graduate of Queens University at Kingston, Ontario, and the University of Chicago, joined the company in 1936.

Dr. Fleming, who joined the company in 1938, is a graduate of Dartmouth and the University of Illinois.

The photo shows, left to right, Dr. Tongberg, Dr. Fleming, and Dr. McNab inspecting a test motor being mounted at the Research Center's motor laboratory.

Higher Octanes Promised Through Better Aromatics

"To improve present-day high octane gasolines—the best ever produced—refineries are constantly seeking better methods to obtain the maximum percentage of aromatic hydrocarbons from each barrel of crude oil," according to Fred Preu, assistant manager of Shell Oil Company's special products department at Rye, N. Y. "The trend is definitely toward aromatics even though they are expensive to make."

Preu spoke before a meeting last month of the American Coke and Chemicals Institute in Rye.

THE OIL MAN'S CALENDAR

1950	
JUNE	
12–16	American Institute of Electrical Engineers, Summer and Pacific General Meeting, Pasadena, Calif., Huntington Hotel.
12–16	American Society of Mechanical Engineers, Oil and Gas Power Division, Baltimore, Md., Lord Baltimore Hotel.
12–16	American Society of Mechanical Engineers, 4th National Materials Handling and Exhibit, Chicago, International Amphitheater.
15–16	Pennsylvania Grade Crude Oil Association, Annual Meeting, Pittsburgh, Hotel William Penn.
18–20	Petroleum Equipment Suppliers Association, White Sulphur Springs, W. Va., The Greenbrier.
26–30	American Society for Testing Materials, 53rd Annual Meeting, 9th Exhibit of Testing Apparatus and Related Equipment, Atlantic City, N.J., Chalfonte-Haddon Hall
JULY	
3– 8	Institute of Petroleum, Second Oil Shale and Cannel Coal Conference, Glasgow, Scot.
AUG.	
14–16	Society of Automotive Engineers, West Coast Meeting, Los Angeles, Biltmore Hotel.
SEPT.	
3– 8	American Chemical Society, Chicago.
5– 9	American Chemical Society, 6th National Chemical Exposition by Chicago Section, Chicago, Chicago Coliseum.
11–15	American Society of Mechanical Engineers, Industrial Instruments and Regulators Conference with the Instrument Society of America, Buffalo, N. Y., Municipal Auditorium.
13–15	National Petroleum Association, Atlantic City, N.J., Hotel Traymore.
1950	
SEPT.	
18–22	Instrument Society of America, National Confernece and Exhibit, Buffalo, N.Y., Memorial Auditorium.
25–27	American Society of Mechanical Engineers, Petroleum Mechanical Engineering Division, New Orleans, The Roosevelt.
OCT.	
1– 3	Independent Petroleum Assn. of America, Annual Meeting, St. Louis, Mo.
2– 6	American Gas Association Annual Convention, Atlantic City, N.J.
15–20	Oil Progress Week.
16–20	National Safety Congress, National Safety Council Exposition, Chicago.
30 to Nov. 1	National Lubricating Grease Institute, Annual Meeting, Chicago, Edgewater Beach Hotel.
NOV.	
2– 3	Society of Automotive Engineers, Diesel Engine Meeting, Chicago, Hotel Knickerbocker.
9–10	Society of Automotive Engineers, Fuels and Lubricants Meeting, Tulsa, Okla., The Mayo.
11–14	Oil Industry Information Committee, Los Angeles, Biltmore Hotel.
15–16	American Petroleum Institute, 30th Annual Meeting, Los Angeles, Biltmore Hotel and Ambassador Hotel.
15–17	National Electrical Manufacturers Association, Atlantic City, N.J., Chalfonte-Haddon Hall.
26 to Dec. 1	American Society of Mechanical Engineers, New York, Hotel Statler.
DEC.	
3– 6	American Institute of Chemical Engineers, Annual Meeting, Columbus, Ohio.

Weather Warning System Planned by Coastal Firms

A weather warning system extending from Brownsville to New Orleans is being formed by a network of Gulf Coast industries, including Pan American Refining Corporation, Texas City; The Central Power and Light Company, Corpus Christi; Dow Chemical Company, Freeport; Celanese Corporation of America, Bishop; Monsanto Chemical Company, Texas City; Carbide and Carbon Chemicals Division, Texas City; and Cities Service, Lake Charles, La.

By tracking the hurricane from as far as 200 miles away, radar can spot a "front" extending 41,000 feet into the sky. The weather bureau, with whom the group will cooperate, relies on land lines for gathering and disseminating its information. Radio transmitters are to be installed at Brownsville, Corpus Christi, Lake Charles, Houston, and New Orleans, pending approval by the Federal Communications Commission. Radar equipment is operating or will be installed at Victoria, Brownsville, Corpus Christi, Freeport and several other points.

It is expected that the system will be in operation during the 1950 hurricane season. Officials expect 50 memberships before starting actual operations. Tem-

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ARTHUR G. McKEE & COMPANY offer many engineering services to petroleum refiners—but only *one* standard of engineering.

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30 Rockefeller Plaza, New York, N. Y.

The MONTH...

porary officers of the association are J. T. Hall, Pan American Refining Corporation, president; Paul Taylor, Central Power and Light, Corpus Christi, vice-president; and Harry Kelso, Monsanto Chemical, secretary-treasurer.

Three Engineers Appointed At Deep Rock Refinery

Promotion of members of the supervisory staff at Deep Rock Oil Corporation's Cushing, Okla. refinery include:

Carlos C. Blount, formerly assistant chief engineer, named refinery safety engineer.

Jon W. Beam, former supervisor of instruments, is new development and instrument engineer.

Former refinery maintenance supervisor, Robert A. Forsman, appointed assistant chief engineer to fill the position vacated by Blount.

Texaco Superintendent

W. G. Copeland has been appointed superintendent of the Eagle Point, N. J. Works of The Texas Company. He succeeds A. M. Martin who is retiring.

Copeland was first employed with Texaco in 1926 as a helper in the lab at the company's Port Arthur, Texas, refinery and as a chemist after his graduation in 1927 from Rice Institute as a chemical engineer. He has served the refining department of the company in New York, France, San Antonio, and Sunburst, Mont.

TEXACO VP HONORED — John H. Holzbog (left), chairman of the New York Personnel Management Association, congratulates James Tanham (right), vice president in charge of industrial and public relations of The Texas Company, on receiving the 1950 Achievement Award of the Association. The award is made annually for outstanding contributions to the field of personnel administration.

Tanham described the efforts in many countries, particularly underdeveloped countries, to industrialize their economy and raise the living standards of their peoples. He pointed out that "the final focal point of many of these efforts lies in the field of human relations in industry." His injunction to management was—"Remember that in labor-management relations you are dealing with people. Keep your eyes open, keep your ears open, but be sure always to keep your heart open."

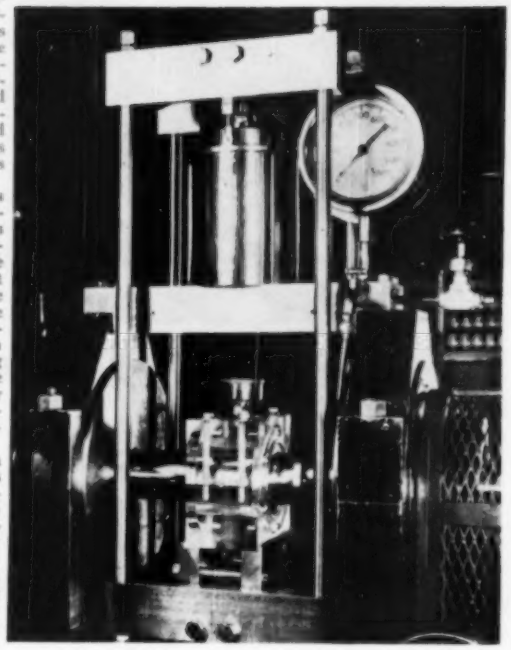
Plastic Bearing for Lubricating Tests

A transparent plastic bearing for lubrication studies has been built by The Texas Company. Using this unit, engineers can see and photograph the behavior of oils and greases in bearings under different loads and speeds.

Bright red dye is mixed with the lubricant so that the lines of flow can be followed. Sensitive scales on the test machine measure the friction drag — the tendency of the bearing to rotate with the shaft. Operating temperatures are measured electrically by means of thermocouples and a potentiometer.

Although a plain journal bearing is under test at present, the machine can be adapted to also study ball and roller bearings.

The special test machine and Lucite bearing were designed and built at the Texaco research laboratories at Beacon, N. Y. The work is being done at the Engineering Experiment Station of the Pennsylvania State College, in collaboration with the staff there.



Imports Promise Increase For Rest of Year

Eleven oil companies which do most of the oil importing have given figures indicating they expect to import 772,450 barrels per day of crude and products in the latter half of 1950, practically the same as in the first half of the year and substantially more than in the latter half of 1949. Other companies not included import approximately 68,000 barrels per day, indicating total imports of about 840,000 barrels per day in the latter half of 1950.

Import forecasts seem unlikely to lessen Texas producers' campaign for a greater share of the domestic market. A statewide Citizens Economic Committee, appointed by Railroad Commission Chairman William Murray Jr. is setting up headquarters at Austin for the purpose of studying the impact of foreign oil on Texas economy and recommending public action, if indicated.

Producers are pleased over the 140,500 barrel per day increase in Texas oil allowables for June, but this results from increased consumption rather than curtailed imports, according to R. L. Foree, president of the Texas Independent Producers and Royalty Owners Association. The organization indicated it might go to Washington for help if importers failed to make satisfactory promises at the Railroad Commission hearing last month.

The Senate Labor Subcommittee, through Chairman Neely (D., W. Va.), said it will be "delighted" to hear a defense of oil imports from the company officials if they "volunteer" to testify. The subcommittee is investigating the effect of oil imports on employment in this country.

Neely explained that he had not solicited any testimony for his hearings and that if testimony favorable to imports is volunteered, his group would hear it.

Pan Am Refining Elects

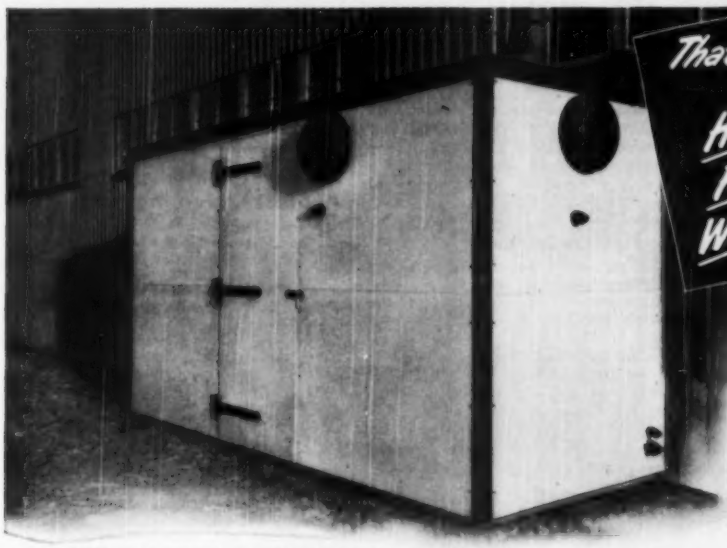
Dr. Harold R. Snow has been elected vice president of Pan American Refining Corporation, with Rodney M. Nash named a member of the board of directors of the refining corporation, Pan American Gas Company, and Mexican Petroleum Corporation of Georgia.

Dr. Snow will continue as plant manager of the Pan American refinery in Texas City, a position he has held since 1947. Nash, who is general counsel of Pan American Petroleum & Transport Company, succeeds P. J. Sweeny, recently elected chairman of the board of directors of Pan American Pipe Line Company.

Pan-Am Southern Names Refinery Executives

Pan-Am Southern Corporation, New Orleans, has elected R. T. Colquette vice president in charge of manufacturing. Dr. J. W. Bertetti was appointed manager of the El Dorado, Ark., refinery; H. K. Wheeler, technical director; J. D. Walk, assistant technical director; and

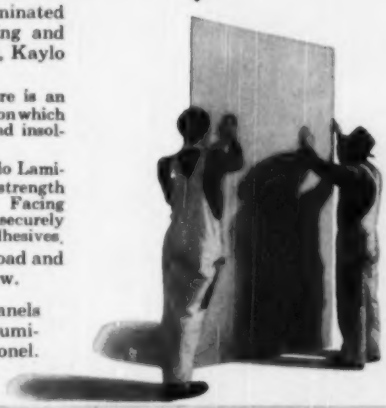
New! KAYLO LAMINATED PANELS Provide Finished Walls



In this typical installation, Kaylo Laminated Panels (with cement-asbestos facing) are used on a valve house.

EASY TO ERECT

Kaylo Laminated Panels are easy to erect, lightweight (only 6 lbs. psf)—can be sawed, nailed or bored with standard tools.



FOR CURTAIN-WALLS OR INTERIOR PARTITIONS, new Kaylo Laminated Panels provide many big advantages to the chemical, refining and allied industries. Available with a number of different facings, Kaylo panels offer these important features:

Fire Protection—The Kaylo core is incombustible. Installed with proper joint systems, Kaylo Laminated Panels (with cement-asbestos, steel, aluminum or Monel facings) meet A.S.T.M. one-hour fire standards.

Insulating Value—Two-inch panels have better insulating value than 16 inches of solid concrete.

Permanence—The Kaylo core is an inorganic chemical composition which is rot-proof, vermin-proof and insoluble in water.

Structural Strength—Kaylo Laminated Panels have great strength and dimensional stability. Facing and core material are securely bonded with waterproof adhesives.

Kaylo Laminated Panels provide better walls, reduced building load and easier erection for nearly every type of building. Investigate now.

A VARIETY OF FACINGS are available on Kaylo Laminated Panels including: cement-asbestos, porcelain enamel, wood veneer, aluminum, steel, plastics, zinc-coated steel, stainless steel and Monel.

KAYLO®
LAMINATED PANELS

OWENS-ILLINOIS GLASS COMPANY
KAYLO DIVISION • TOLEDO 1, OHIO
SALES OFFICES:
Atlanta • Boston • Buffalo • Chicago • Cincinnati • Dallas • Minneapolis
New York • Philadelphia • Pittsburgh • St. Louis • Toledo • Washington

Send Coupon for Literature!

OWENS-ILLINOIS GLASS COMPANY
Kaylo Division, Dept. N-88, Toledo 1, Ohio

Gentlemen: Please send me literature on Kaylo Laminated Panels.

NAME.....

FIRM.....

ADDRESS.....

CITY..... STATE.....

The MONTH...

R. R. Gumaer, technical assistant to Colquette.

Colquette, who was recently elected a director of the corporation, will move from El Dorado to New Orleans as will Gumaer. Dr. Bertetti, former technical director, Wheeler, his assistant, and Walk will remain in El Dorado.

Pan-Am Southern Executives

H. S. Read, vice president and chairman of the corporation's marketing committee, was also named chairman of the supply and transportation committee, succeeding Bruce K. Brown, president of the company. Robert L. Aycock, New Orleans, general manager of bulk sales, also has been named vice president and a director.

Sun Accidents Drop

Personal injury accidents dropped 22 percent in the past year at Sun Oil Company's Marcus Hook, Pa. refinery. Sixty Pennsylvania Department of Labor & Industry certificates were awarded to units within the refinery which had either an accident-free year or better-than-state-average for safety in 1949.

This is the 18th consecutive year that the Marcus Hook refinery has been cited by the state for its safety record.

Development Firm Elects

American Development Corporation, New York, has elected officers as follows: Joseph H. Salmon, president; Dr. Charles W. Rippie, vice president and technical director; and Peter J. Gaylor, secretary-treasurer.

California Standard Elects

K. H. Crandall has been elected a vice president of Standard Oil Company of California. Since 1947 Crandall has been vice chairman of the board of The California Company and since 1948 a director of Standard Oil Company of Texas.

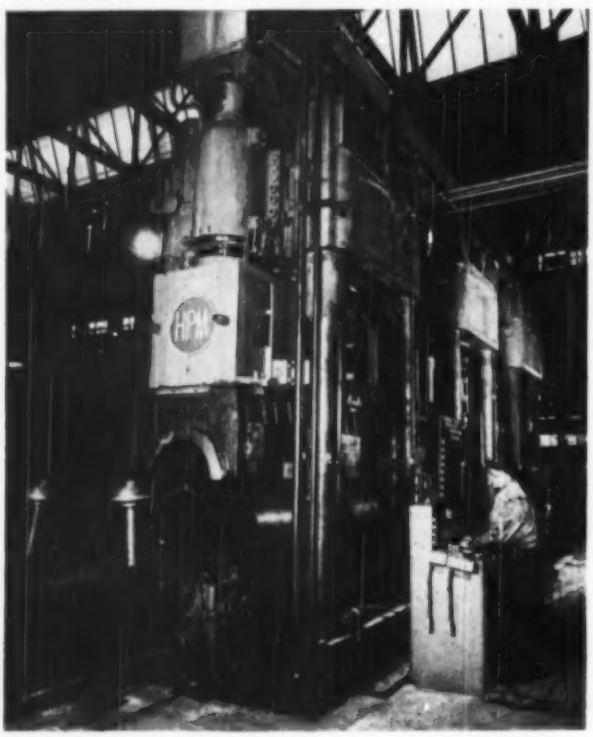
New Mill Streamlines Big Pipe Production

A new mill of United States Steel's National Tube Company at McKeesport, Pa., has begun making pipe large enough to deliver 344 million cubic feet of gas every 24 hours.

The mill is geared to turn out annually 100,000 tons of electric welded and hydraulically expanded steel pipe, ranging up to 36 inches in diameter. Initial production is on an order for 30-inch size.

The new facilities make up a compact, streamlined production unit, involving the use of roller conveyors to move the heavy steel pieces of semi-finished pipe from machine to machine, much like the assembly-line operation in automobile plants.

Among the major units in the production line are a 2000-ton hydraulic press, identified as a U-ing press because it forms the steel plate into a U shape, and an 18,000-ton hydraulic press that forms the U-shaped piece into its finished round shape. **(Latter press pictured below.)**



Reprint Policy

A change has been made in PETROLEUM REFINER's policy with regard to small, individual orders for reprints of its articles. Since January 1 a charge of 50 cents per copy has been made WHEN REPRINTS ARE AVAILABLE. This will continue.

The charge for tear sheets of a particular article, effective April 1, has been reduced to 25 cents.

Cash or company requisitions should accompany all such "individual" orders.

This change does not affect the price for quantity orders of reprints (starting at 100 orders) which will be quoted upon request.

Antitrust Suit Filed Against Seven Majors

Seven major oil companies operating on the west coast have been named defendants in an antitrust suit filed in the U. S. District Court, Los Angeles, by the Justice Department. Defendants are Standard Oil Company of California, The Texas Company, Shell Oil Company, Tide Water Associated Oil Company, Richfield Oil Corporation of Los Angeles, General Petroleum Corporation, and Union Oil Company of California. Named as joint-defendant was the Conservation Committee of California Oil Producers, a voluntary unincorporated association organized for what the department says is the purpose of controlling and regulating production of crude oil in California. Dissolution of the committee is asked.

Also the suit asks that each of the defendants divorce itself of bulk plants and company-owned retail stations and to release company-controlled stations from exclusive-dealing contracts. Other provisions called for are the abolition of the private prorate system at the production level and the assumption by the majors of a "true common-carrier status" with respect to the operation of their pipe lines and other transportation facilities.

Southwest Research Head

C. Desmond Pengelley of Columbus, Ohio, has been appointed chairman of engineering mechanics for Southwest Research Institute, San Antonio. As former flutter section head for Curtiss-Wright Corporation, Pengelley was connected with flutter vibration and aeroelasticity, aerodynamics, static testing, stress analysis, and landing gear layout.

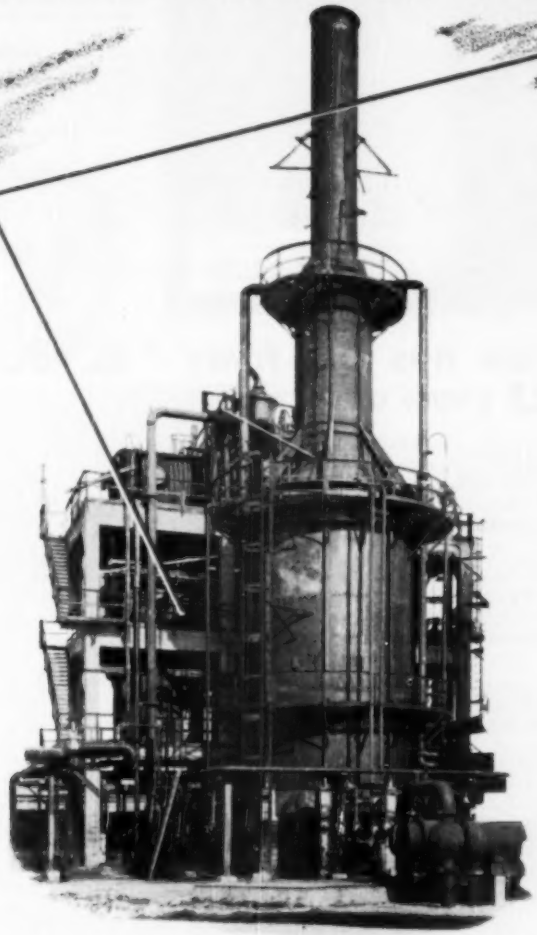
Midwest Research Elects

Charles Newton Kimball, Sc.D., has been elected president of the Midwest Institute, Kansas City, Mo. Other officers are George E. Ziegler, Ph.D., director of research, Leon T. Swan, vice president and treasurer, S. C. Lechtman, secretary, and V. L. Barnett, assistant treasurer.

Elected to Academy

E. V. Murphree, president of Standard Oil Development Company, central technical and research organization of Standard Oil Company (New Jersey), has been elected to membership in the National Academy of Sciences. The acad-

First HORIZONTAL KASKADE VACUUM TOWER



GIVES REMARKABLE OPERATION

at the Hartford, Illinois, refinery of Wood River Oil and Refining Company.

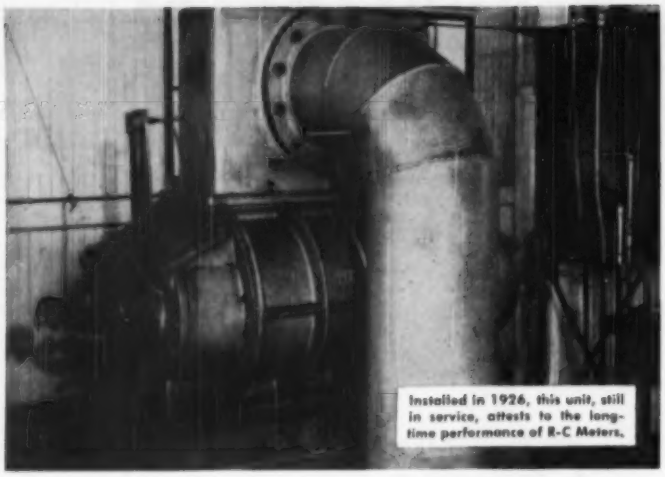
This wet vacuum unit operating on heavy reduced Wyoming, West Texas and Oklahoma crudes produces negative oliensis asphalts. Pressure drop through six (6) horizontal Kaskade trays four to six millimeters of mercury.

We will be glad to tell you how the Kaskade tray can be adapted to your vacuum services. *Write us today, no obligation.*

THE KOCH ENGINEERING COMPANY, INC.

Designers — Manufacturers — Builders

[illegible] WEST LEWIS STREET — WICHITA 5, KANSAS



Installed in 1926, this unit, still in service, attests to the long-time performance of R-C Meters.

NO PENSION FOR THIS OLD-TIMER even after *23* years of service

Accurate and dependable as always, this 23-year-old Roots-Connersville Meter still performs faithfully. No retirement for this veteran! Because new demands called for higher capacity, it has been transferred to another job in the same plant. Its old duties have been taken on by a new R-C unit, purchased because of fine performance of this old-timer.

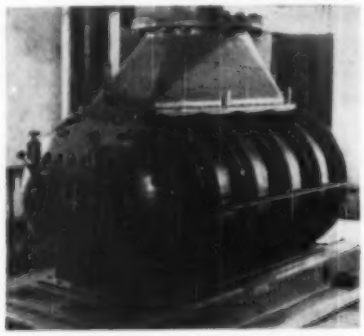
That's a common history of R-C Meters. They're built to measure accurately, and keep on doing it, year after year. Simple design, finely-machined measuring surfaces and other important refinements account for their ability to measure gas accurately and unfailingly, almost indefinitely.

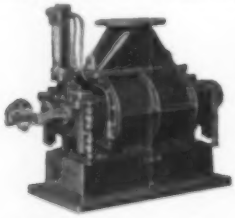
With 31 standard sizes and capacities from 4,000 to 1,000,000 cfh, R-C Meters meet the needs of most applications. Write for Bulletin 40-B-14 or tell us your specific requirements.

ROOTS-CONNERSVILLE BLOWER CORPORATION
506 Cresent Avenue, Connersville, Indiana

(Right) This R-C Meter, with capacity of 317,000 cfh, replaced the "old-timer" above, now transferred to other duties.

(Below) Typical small capacity R-C Meter for low and medium pressures.





ROOTS-CONNERSVILLE
BLOWER BUILDERS SINCE 1854
ONE OF THE DRESSER INDUSTRIES

The MONTH...

emy, composed of leading scientists, engineers, and physicists in the U. S., serves to investigate, examine, experiment, and report upon any subject of science whenever called upon by any governmental department. Grants-in-aid are also made to colleges and universities.

Phillips Employes Named To Industrial Committees

Three members of Phillips Petroleum Company's chemical engineering division have been appointed to various industry committees. D. D. Buttolph, E. W. Evans, and P. W. Tucker were named to replace E. O. Mattocks who recently resigned from Phillips to take a position with the American Petroleum Institute.

Evans

Buttolph

Tucker

Buttolph, manager of the instrument and equipment branch and with the company since 1940 is serving on committees of the AGA, API, Compressed Gas Association, National Fire Protection Association, and LPGA.

Evans, with Phillips since 1925, is serving on committees of the AGA, API, American Society for Testing Materials, and the LPGA. He is a technical advisor on supply and demand, specifications and test methods, distribution, transportation, packaging, waste disposal, pollution, combustion and fuel utilization, odorization, storage and handling of liquefied petroleum gas and chemicals.

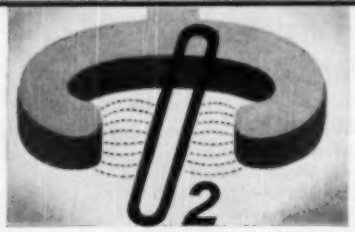
Tucker, presently a technical advisor on liquefied petroleum gas and chemical problems, joined Phillips in 1948 after receiving his Ph.D. at the University of Missouri. He is with the LPG subcommittee of the Natural Gas Association of America, the specifications and safety committees of the LPGA, and the metal packages committee of the Manufacturing Chemists Association.

LPG Group Elects New President and Officers

Peter A. Anderson, president of Utilities Distributors, Inc., Portland, Me., last month was elected president of the Liquefied Petroleum Gas Association. He succeeds Si G. Darling, president, Darlingas, Inc., Pratt, Kan.

Other officers for 1950-51 include William S. Lander, Rulane Gas Company, Charlotte, N. C., first vice presi-

Six Reasons Why HAYS = O_2 LEADERSHIP!

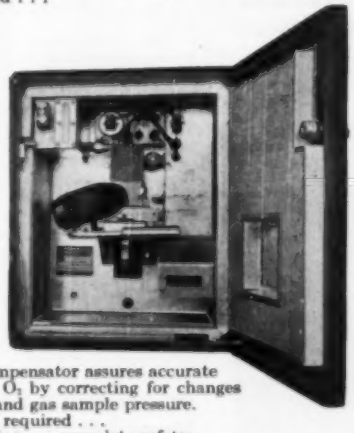


1 HAYS WAS ONE OF THE FIRST TO RECOGNIZE AND APPLY THE PARAMAGNETIC PRINCIPLE

As early as 1909, Joseph Hays recognized the need for an Oxygen Recorder. Thirty years and five oxygen analyzing instruments later, Hays research engineers had a principle worth complete exploitation—the paramagnetic qualities of oxygen. Then followed . . .

2 MONTHS OF CONTINUOUS LABORATORY RESEARCH

Once it had been established that magnetically induced thermal resistance changes accurately mirrored O_2 content changes in a gas sample, millionfold amplification was required. Existing amplifiers proved inadequate, so Hays designed their own. When their Analyzer and Recorder were completed, it became clear that Hays had an instrument with unequalled . . .



3 PRACTICAL DESIGN FEATURES

Positive, instant zero check through free swinging magnet. High sensitivity, rapid response to O_2 changes—rugged construction.

Patented compensator assures accurate readings in % O_2 by correcting for changes in barometric and gas sample pressure.

No chemical required . . .
No combustion . . . complete safety
No gaseous or liquid fuels added to gas sample
Provision for 4 records on one chart

4 PAINSTAKING, PRECISION FABRICATION

High accuracy and sensitivity require close tolerances—production problems arose. Hays solved these problems by investing large sums in new machines, by building their own equipment not available elsewhere, by using their 40 years of instrument manufacturing "know-how." When finished, the new O_2 Recorders were subjected to . . .

5 FOUR YEARS OF INTENSIVE FIELD RESEARCH

Test installations were made in the oil, steel and glass industries; power plants, and laboratories. Instrument performance was noted under varying conditions, findings were then translated into product improvements. New compensations, calibrating techniques and adjustments were developed, giving Hays a wealth of . . .

6 APPLICATION "KNOW-HOW"

You benefit by Hays knowledge gained in working with 200 leading industrial users . . . experience in applying the Magno-Thermo O_2 Recorder to Catalyst regenerators, process heaters, heat treating furnaces, open hearths, government laboratories and similar operations.

BULLETIN 49-829 free for the asking, describes the principle and operation of this instrument . . . write for it!

The Hays CORPORATION
MICHIGAN CITY INDIANA U.S.A.

THE HAYS CORPORATION
Michigan City 10, Indiana
Please send me Bulletin 49-829 which describes the Hays Oxygen Recorder and Analyzer

Name _____
Company _____
Address _____
City _____ Zone ____ State _____

SPECIFY "International"

FOR COMPLETE SERVICE AND DEPENDABILITY

You can't beat INTERNATIONAL REFINERY MIXING EQUIPMENT for the most rapid and economical blending of Gasoline, Gasoline Ethyl mixing, lubricating and fuel oil blending, as well as by-products liming, caustic and doctor treating . . . This up-to-date equipment is indispensible in cycling operations and pipe line work, and for uniformity in charging stock — mud mixing — a "natural" for research, laboratory and pilot plants.

Call on INTERNATIONAL'S vast experience for assistance in solving your Mixing and Blending problems. Our Engineering staff is at your service. Remember, INTERNATIONAL builds and guarantees the equipment you need for the best possible results at the lowest possible operating cost. Write for catalog and complete information on Top Entering, Side Entrance and Portable Mixers today.

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DISTRICT REPRESENTATIVES IN PRINCIPAL CITIES

The MONTH...

dent; F. N. Mabee, Colorado Natural Gas & Fuel Company, Denver, Colo., second vice president; Walter Miller, Dri-Gas Corporation, Chicago, treasurer, and Arthur C. Kreutzer, Chicago, secretary, vice president, and general counsel.

Howard D. White, former executive vice president of the LPGA, has returned in that capacity, after serving with Perlite Development Corporation, Albuquerque, N. M., since last October.

Refinery Superintendent Ends 30 Years With Shell

As superintendent of operations for Shell Oil Company's Houston refinery, J. L. Miller, has completed his thirtieth year with the company. Miller started with Shell in 1920 as a gauger at the company's Wood River, Ill., refinery from which he was transferred to the company's former Arkansas City refinery in 1923 as assistant head stillman. He later became assistant superintendent in 1927. The next year, he was transferred to a refinery which Shell then had at East Chicago, Ind. In 1937 he moved to Houston.

Miller

During the war, Miller was in charge of petroleum supplies for the Army ground forces in the Southwest Pacific theatre of operations.

Estimate on Natural Gas Inroads on East Coast Oil

Natural gas on the East Coast in the next three years will cut the expected increase in distillates demand by one-third, and set back residual 75,000 barrels per day, but begin to taper off after 1952.

This recent forecast of Courtney C. Brown, Standard Oil Company (New Jersey) economist, was based on the observation that, while the U. S. is proving up about twice the volume of natural gas reserves that it is consuming every year, this is "not enough to maintain very long the ratio of 20 to 1 between proved reserves and annual deliveries that the Federal Power Commission has required before approving large investments in cross-country transmission lines."

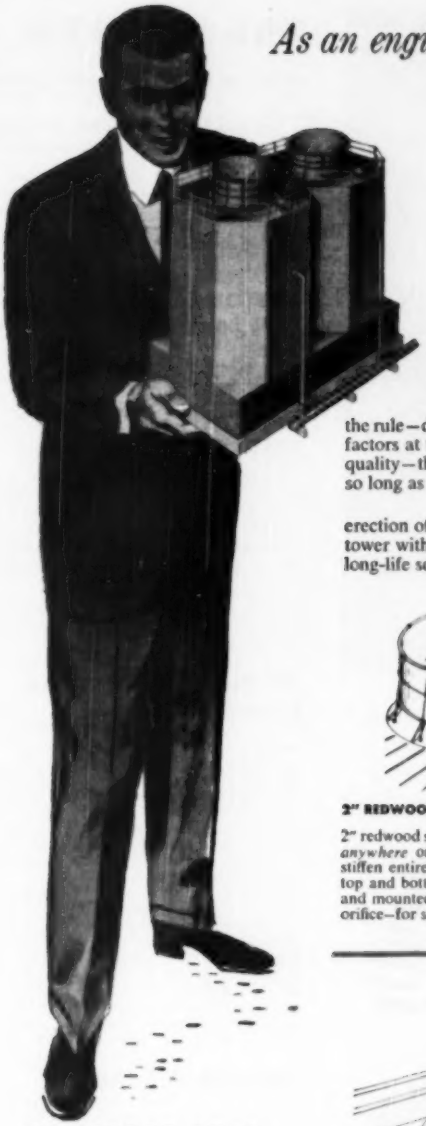
In regard to the outlook for refinery operations, Brown claims that, east of California, the middle fractions will have to continue to produce at a higher rate this summer than last, in order to avoid supply difficulties next winter.

Dr. Frederick Rossini Named to CIT Professorship

Dr. Frederick D. Rossini will join the faculty of Carnegie Institute of Technology July 1 in a new chemistry professorship which has been established through a $15,000 grant by Gulf Oil Corporation. Dr. Rossini is currently chief of the thermochemistry and hydrocarbons section of the National Bureau of

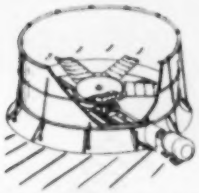
As an engineer you will appreciate...

The RUGGED DESIGN inherent in the 1950 FLUOR COUNTERFLO Cooling Tower



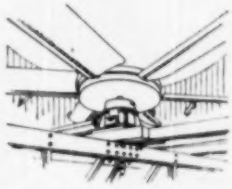
Ruggedness is a prerequisite in cooling tower design and performance. Without it, inefficiency and costly maintenance becomes the rule—drop in plant production is the end result. Regardless of the influencing factors at time of purchase—low first cost, claims of efficiency or statement of quality—the cooling tower you select will meet performance requirements *only* so long as its original structural design endures.

Thirty years' intensive development in the design, fabrication and erection of cooling towers enables Fluor to offer you a better cooling tower—a tower with comparable first cost, the highest obtainable efficiency and rugged, long-life service.



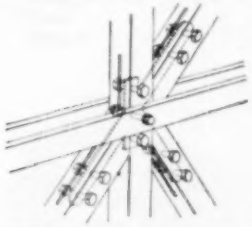
2" REDWOOD IN FAN DECK and STACK

2" redwood supports 1000#/sq. ft. load *anywhere* on deck—heavy enough to stiffen entire structure. Stack is ringed top and bottom with heavy angle iron and mounted on a metal bell-mouthed orifice—for safety and savings in power.



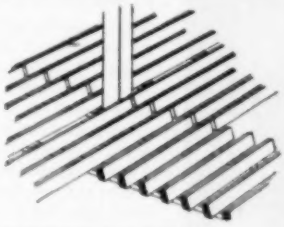
RUGGED GEAR UNIT and FAN BLADES

Gear unit is designed *specifically* for cooling tower service. Result: Less than ¼ of 1% replacement parts! Heavy Stainless Steel Fan Blades give a larger moment of inertia—tips are strong enough to hold a man's weight.



STRONGER STRUCTURAL DESIGN

Internal gusset plate and bolt-type joints enable structural members to take *both* tension and compression loads—a design *in accordance* with the rigid requirements of major city codes and recent findings of the U. S. Forest Products Laboratory.



1" REDWOOD GRID DECK FILLING

Grid decks consist of heavy 1" redwood nailed individually on sturdy cleats—strong enough for use as scaffolding during tower erection, durable enough to permit repeated removal for cleaning or fire hosing without removing from tower.

CONSIDER THIS about

"Guaranteed Performance"

Fluor's "Guarantee of Performance" is based on a true bid to meet specified performance requirements. There is an old saying, "You can't get something for nothing." This is particularly true in the purchase of cooling towers—a bid allowing performance to be off only 2 or 3 degrees on the approach may seem insignificant at time of purchase, but it can mean as much as 30 to 40% difference in the size of tower necessary to do the specified job! Often this is overlooked if a tower is purchased on price alone.

For your protection compare the probable performance of the towers offered before making a decision. Analyze your cooling tower bids thoroughly!

FLUOR

BE SURE WITH FLUOR

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The MONTH...

Standards and was recently appointed head of Carnegie's chemistry department.

The new chair will be named for Benjamin Silliman, a distinguished scientist of the 1800's and a pioneer in the chemistry of petroleum refining. Silliman, a Yale University professor, published one of the early reports which showed the composition of crude oil and made recommendations for its use as an illuminant and for other purposes.

Gulf Oil Executive Retires With Longest Service Record

After 43 years of service with Gulf Oil Corporation, General Walter B. Pyron, vice president, retired last month with the longest service record of any production department official. General Pyron plans to take up residence in San Antonio where he will devote interest to the oil business and military affairs.

Formerly, as Brigadier General of the U. S. Army, General Pyron, together with Admiral A. F. Carter, formed the wartime Petroleum Board. Just recently General Pyron has returned from Europe where, since 1945, he has been establishing Gulf offices in London and serving as director of Kuwait Oil Company, a Persian Gulf producing company jointly owned by Gulf and Anglo-Iranian Oil Company.

FTC Doubts Competition Exists in Industry

The Federal Trade Commission has raised what it terms a "grave question as to whether there is competition in the petroleum industry since its official indorsement late last month of the Cannon Resolution. Five witnesses appearing before the House Commerce Sub-Committee urged enactment of the resolution to authorize a $250,000 FTC monopoly probe of petroleum.

Indorsers of the Cannon measure were Representative Cannon (D. Mo.), A. D. Sappington, general counsel of Missouri Association, a co-op, operating refineries; Robert Freer, Washington lawyer and former chairman of FTC who appeared as representative of the National Congress of Petroleum Retailers; Lloyd Halvorson, National Grange; and Benton J. Strong, National Farmers Union.

Millionth Safe Hour

A million man-hours or almost ten years, without a lost-time accident, is the safety record of 49 men and employes of Stanolind Oil and Gas Company's Pine Island area, La. Four other areas holding the same record are the Yates area, West Texas, the Wewoka area of Oklahoma, the Hastings area near Houston; and the East Texas area where employes last month completed their second such record.

US Steel Executive Retires

Gordon L. Edwards, vice president and treasurer of United States Steel Corporation, will retire this month after more than 50 years of service with the company and one of its predecessors, National Tube Company. In 1899 Edwards began with National Tube in New York as office boy. When United States Steel was organized in 1901,

Edwards was transferred to the treasurer's office as clerk in the cashier's office. He has served continuously in the treasurer's office since that time.

Sinclair Buys Portion Lisbon Gasoline Assets

Sinclair Oil and Gas Company has purchased a one-half interest in the physical assets of the former Lisbon Gasoline Company, Inc. These assets consist of two natural gasoline extraction plants, with field gathering and residue systems, located in the south end of the East Texas field. More than 1400 wells with a production of approximately 10 million cubic feet of casinghead gas supply these plants, which have productive capacity of about 60,000 gallons of natural gasoline and butane, and 40,000 gallons of propane daily.

At the expiration of the present existing gasoline sales contracts, the products from this project will be available to Sinclair. Arkansas Fuel Oil Company owns the remaining half interest. Sinclair will operate the plants through its Tulsa office.

Italian Project Guarantee Is Given Jersey Standard

Standard Oil Company (New Jersey) has received a $12 million government guarantee in Italy, said to be the largest in the history of the Economic Cooperation Administration's $150-million guarantee program. Under the transaction, Jersey Standard can convert back into dollars its $12 million investment, plus $2,487,000 in earnings over the next 12 years.

In the arrangement, Jersey Standard is to put $12 million into the capital stock of a new Italian refining corporation, to be called STANIC, for this amount. Standard will get half of STANIC's capital stock. The other half will be owned by an existing Italian company, known as ANIC, in which the Italian government has a large interest.

New name for the company owning and operating the Bari and Leghorn refineries is Stanic Industria Petrolifera Societa Per Azioni.

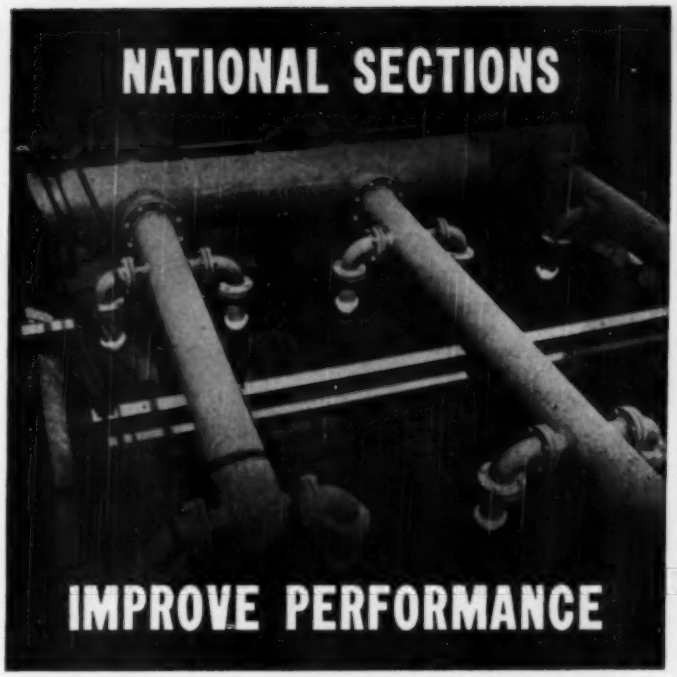
Of Standard's total investment, $10 million will be used to buy a half interest in ANIC's present refineries at Bari and Leghorn, Italy. The other $2 million will be spent for US refining equipment.

Officials said an outlet for Standard's new company is assured in Italy because a Standard subsidiary already has a well-established marketing association there.

The Bari refinery has a capacity of $12,000 barrels of crude and is to be modernized. The Leghorn refinery, processing about 7500 barrels of crude a day, will be boosted to a 21,000 barrel capacity. ECA estimated the additional capacity at Leghorn will cut Italy's purchases of dollar oil by $4.2 million.

Heads Ethyl Products Unit

William T. Hack has been named manager of the product development department, Ethyl Corporation. A former member of the product development staff, he joined Ethyl in 1946 and resigned two years later to accept an appointment as director of the chemical and rubber division of the National



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The MONTH...

Security Resources Board, Washington, D. C.

Hack was also engineer with Carbide and Carbon Chemical Corporation, South Charleston, W. Va., the Office of Rubber Reserve production manager of the butadiene-from-alcohol section, and later assistant production manager of the synthetic rubber section. He was graduated from Princeton University in 1935 with a B. S. degree in chemical engineering and attended the graduate school of business administration at Harvard University.

Test of New Refrigerant Shows Gain in Capacity

Reporting for the first time on the performance and application of the newly-invented refrigerant, Carrene-7, C. M. Ashley, chief development engineer for Carrier Corporation, told the American Society of Refrigerating Engineers early this month in Kansas City, Mo., that field and laboratory tests proved it would meet refrigeration capacity and horsepower requirements of 17 to 18 percent more than Freon-12 for a given compressor displacement. Ashley stated Carrene-7, as a companion to Freon-12, was applicable to a wide range of refrigeration systems "where additional capacity is desired."

The new refrigerant, he said, should be "especially useful" in the following situations:

Filling job requirements falling between existing compressor capacities; matching additional motor sizes within and beyond the Freon-12 compressor line for air conditioning loads; utilizing full motor capacities for commercial refrigeration; increasing the capacity of existing installations, and raising the capacity of 25 and 50-cycle systems to equal the 60-cycle system using Freon-12.

Carrene-7 has not yet been made available commercially. It was invented by Dr. W. A. Pennington, chief chemist and metallurgist at Carrier, and W. H. Reed, former Carrier fellow at Syracuse University, and was announced recently before the American Institute of Chemical Engineers.

Ashley reported that the new refrigerant operates at approximately 18 percent higher pressure than Freon-12 at the same temperature and that the refrigeration systems must be suitable to withstand this pressure.

He added that Carrene-7 had met design objectives as to high chemical stability, had proved non-flammable at reasonable temperatures and had passed satisfactorily through tests for toxicity and corrosive qualities.

Describing direct comparative tests between the performance of a 5-hp. compressor using Carrene-7 and Freon-12 under identical conditions, Ashley stated that Carrene-7 showed a capacity of 17.5 percent more than Freon-12 and a power input of 17.3 percent more when running at 1750 rmp.

A further laboratory check on relative performance was made in a 3-ton self-contained unit, he continued, with the Freon-12 compressor operating at 60-cycle speed and the Carrene-7 at 50 cycle. Tests were run with 67 and 78° entering wet bulb air temperature and with 75° entering and 95° leaving water temperature. The Carrene-7 tests at the

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The MONTH...

50-cycle speed showed slightly better performance than the Freon-12 at 60-cycle, he said.

Southeastern Oil Samples

Analyses of 51 samples of crude petroleum from six southeastern states—Alabama, Florida, Kentucky, Mississippi, Tennessee, and Virginia—are given in a report of the Bureau of Mines. This study was conducted under the general supervision of R. A. Cattell, chief of the Petroleum and Natural Gas branch, and H. C. Fowler, supervising engineer of the Petroleum Experiment Station at Bartlesville, Okla.

Wide variation is shown in the physical and chemical properties of the samples. The publication contains data on the sources and properties of the crudes analyzed, as well as information regarding the areas represented, year of discovery of each field, production in 1948, and total reported production by field and state through 1948. It also includes a list and bibliography of analyses of crude oils from this region since 1921.

For a free copy of Report of Investigations 4687, by O. C. Blade and E. L. Garton, petroleum chemists, write the Bureau of Mines, Publications Distribution Section, 4800 Forbes St., Pittsburgh 13.

Beard Joins Ebasco

C. S. (Chet) Beard has joined Ebasco Services Incorporated, New York, as gas engineer. He had previously been instrument engineer with Bechtel Corporation in San Francisco. Beard studied engineering at the University of Minnesota and the University of Southern California. He is past president of the Instrument Society of America, Northern California Section, a member of ASME, and a registered professional engineer.

Oil Progress Week Theme

"Your Progress and Oil Progress Go Hand in Hand" has been selected by the Oil Industry Information Committee as the central theme of Oil Progress Week, October 15-21.

Graver Head Dies

Edward B. Heyden, 52, head of Graver Construction Company, and vice president of Graver Tank & Manufacturing Company, Inc. died at his home in Cranford, N. J. April 18. Heyden had been associated with Graver since 1946 and had personally supervised Graver construction projects. For 14 years previously, he was general superintendent for The Lummus Company.

Powell Valve Agent Dies

William H. (Bill) Tharp, Worthington, Ohio, died May 10 after a brief illness. For the past three years Tharp represented The Wm. Powell Company, valve manufacturers of Cincinnati, Ohio, throughout the mid-Ohio territory.

Chief Accountant Dies

John B. Bass, 48, chief accountant at Continental Oil Company's Ponca City, Okla., refinery, died April 19, after a heart attack. He had been with Continental 20 years.

Put CUPRO-NICKEL in to keep CORROSION out

Aship and ashore, vital metal parts of many types of equipment often operate under conditions exposing them to salt water corrosion. And that's where cupro-nickel alloys prove their worth . . .

In fact, during World War II, all available 70-30 copper-nickel condenser tubes were reserved exclusively for Naval vessels and tankers.

And the reason? Because thin walls of this strong, tough alloy resist corrosive and erosive attacks from salt water. This resistance extends to sea water containing entangled air bubbles, which passes through condenser tubes at high velocities, and to polluted, silt-laden waters of harbors and estuaries.

In addition, the 70-30 alloy combines outstanding resistance to pitting and stress corrosion cracking, plus maximum resistance to dezincification, together with the ability to withstand a wide variety of corrosive agents.

APPLICATIONS

Ocean-going ships equipped with cupro-nickel condenser tubes and piping can travel hundreds of thousands of miles and many years longer without layovers for tube replacement . . . a particularly important advantage for merchant vessels.

But that is only one example. Cupro-nickel alloys have established outstanding service records in applications ashore as well as at sea. They serve in sugar mills, oil refineries and power plants . . . in vital parts of feed water heaters, condensers, evaporators and other heat exchangers . . . in oil coolers, stills, water boxes, piping, tanks, and other equipment.

Cupro-nickel alloys eliminate those hidden taxes on profits represented by maintenance, replacement expense, loss of heat transfer capacity and interruptions of operation resulting from corrosion.

TYPES AVAILABLE

Cupro-nickel alloys are available in many types containing various percentages of nickel. The most widely used for condenser tubes and marine shore station applications is composed of 70% copper and 30% nickel. Another which is gaining wide acceptance is the new iron modified 90-10 cupro-nickel.

Cupro-nickel is available as tubing, rod, strip, wire and sheet, and also in cast form.

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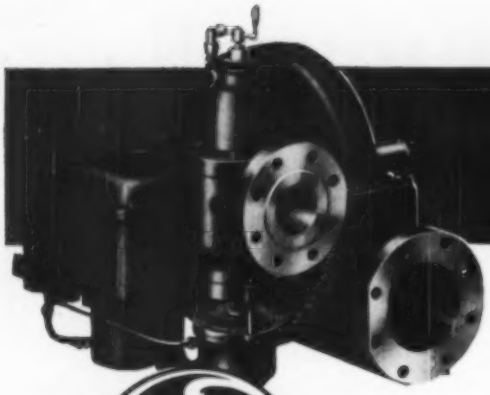

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General Electric's DP turbines, available in three frame sizes and a variety of ratings, can be profitably used in many different applications, yet they compose a standard line and incorporate standard parts. This standardization gives you four important benefits:

1 EASY TO STOCK SPARES Because most parts are interchangeable on all models, spares can be stocked at low cost. A spare parts kit, containing 91 items, can be obtained with the turbine. This simple method of stocking spares lowers maintenance costs and provides protection for several DP's in your plant.

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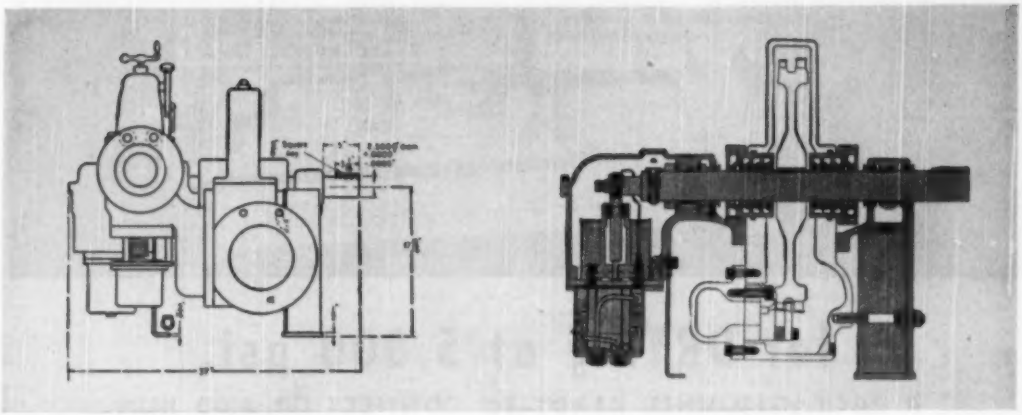

2 INSTALLATION SIMPLIFIED

All models, regardless of frame size, horsepower, or speed ratings, have identical shaft height, keyways, and coupling fits. Thus, installation problems are simplified, and you can move these center-line supported units from job to job without a "custom line-up."

3 GREATER FLEXIBILITY

As the shaded parts in the diagram illustrate, most DP parts are identical on all frame sizes and ratings. In this way, you can adapt a DP for different job requirements with only minor changes. A different nozzle plate gives you a different horsepower output. A change in governor gears provides a new speed range. When modernization programs demand a change in plant operation, the DP's flexibility will save you money.

4 A BETTER TURBINE

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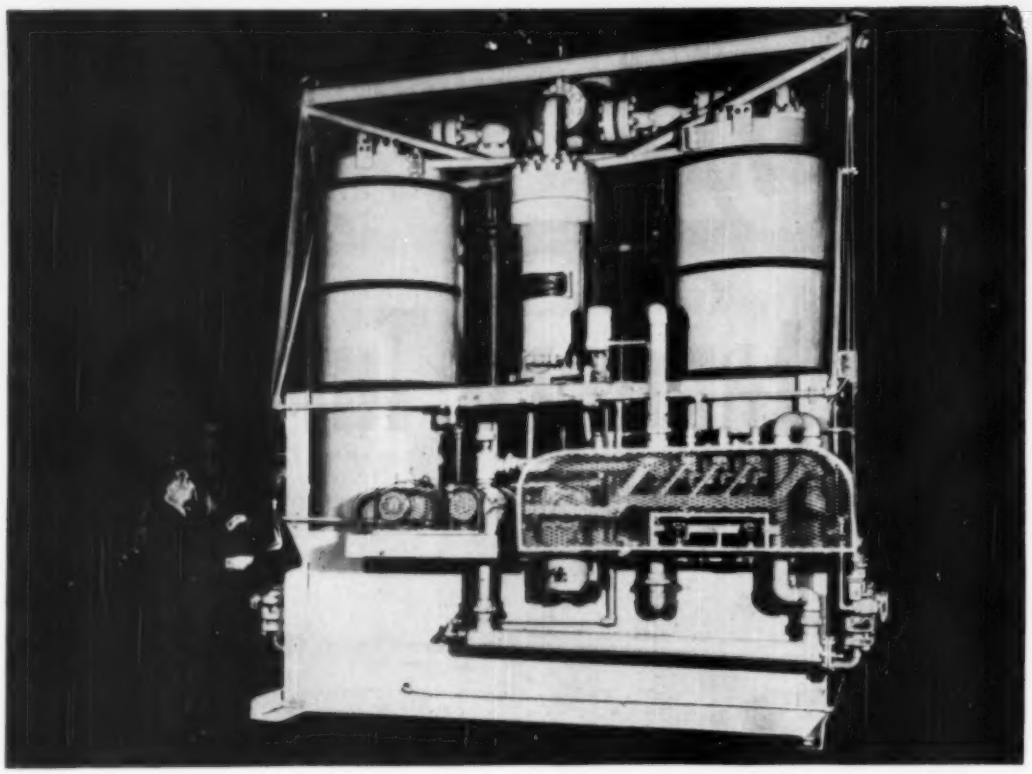

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SCIENCE and TECHNOLOGY Abstracts

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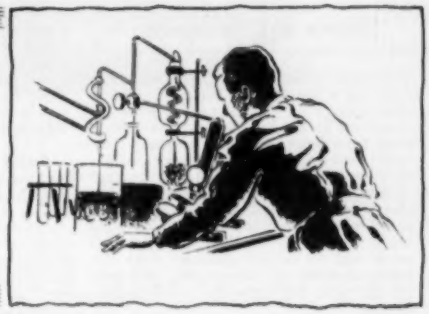


Fundamental Physical and Chemical Data

Volumetric and Phase Behavior of Propene-1-Butene System. G. H. Goff, P. S. Farrington, and B. H. Sage. *Ind. Eng. Chem.*, **42** (1950), pp. 735-43.

Although many data are available on the volumetric and phase behavior of hydrocarbon systems, no work on binary olefinic systems is reported in the literature. Propene and 1-butene are olefins of importance as raw materials in the synthetic chemical industry. Volumetric behavior of four mixtures of propene and butene-1 was determined experimentally at seven temperatures between 40° and 280° F. for pressures up to 10,000 psi. Compositions and specific volumes of the coexisting phases were established throughout the two-phase region at temperatures above 40° F. The equilibrium constants for propene and 1-butene were computed and are reported as functions of state. The experimental results are presented in detail in tabular and graphical form and a bibliography of 18 references is given.

Vapor-Adsorbate Equilibrium. I. Propane-Propylene on Activated Carbon and on Silica Gel. W. K. Lewis, E. R. Gilliland, B. Chertow, and W. H. Hoffman. *Jour. Am. Chem. Soc.*, **72** (1950), pp. 1153-7.

The potentiality of separating gases on an industrial scale by adsorptive procedures led the authors to a study of the equilibria involved when gaseous mixtures of hydrocarbons are in contact with solids of large specific surface area. The adsorption isotherms of the individual components, and, in the case of mixtures, the composition of the vapor and adsorbate in equilibrium with each other, were determined. The conditions of equilibrium were ascertained by approaching the equilibrium from both sides. The authors present the results obtained when gaseous mixtures of propane and propylene were permitted to come into equilibrium with an activated carbon or a silica gel at 25° C. and atmospheric pressure. This system is of interest because the physical properties of these gases are very similar and separation by standard distillation procedure is difficult. Little difference in the relative volatility of these gases was found over activated carbon, but a substantial difference over silica gel. In these vapor-adsorbate equilibria propane is the more volatile component, whereas in the vapor-liquid equilibrium for this hydrocarbon system propane is the less volatile component.

Vapor-Adsorbate Equilibrium. II. Acetylene-Ethylene on Activated Carbon and on Silica Gel. W. K. Lewis, E. R. Gilliland, Bernard Chertow, and W. Milliken. *Jour. Am. Chem. Soc.*, **72** (1950), pp. 1157-9.

The vapor-adsorbate equilibrium was investigated for binary gaseous mixtures of acetylene and ethylene at 25° C. and atmospheric pressure. The adsorption-desorption isotherms were determined on activated carbon and on silica gel. Acetylene is more volatile than ethylene over activated carbon and is less volatile over silica gel. The adsorption phenomena studied were found to be reversible and equilibrium was approached from both directions.

Vapor-Adsorbate Equilibrium. III. The Effect of Temperature on the Binary Systems Ethylene-Propane, Ethylene-Propylene Over Silica Gel. W. K. Lewis, E. R. Gilliland, B. Chertow, and D. Bareis. *Jour. Am. Chem. Soc.*, **72** (1950), pp. 1160-3.

Vapor-adsorbate equilibria for gaseous mixtures of ethylene-propane and ethylene-propylene were determined using silica gel as the adsorbent and at barometric pressure and at 0°, 25° and 40° C. Ethylene is relatively more volatile than propane or propylene in the isobaric, isothermal binary systems. Ethylene exhibits a much greater relative volatility in the propylene system than in the propane system, which demonstrates the influence of the double bond. The adsorption phenomena were found to be reversible.

n-Decane-trans-Decahydronaphthalene. Binary Mixture for Determining Efficiencies of Fractionating Columns Operating at Reduced Pressures. M. R. Fenske, H. S. Myers, and Dorothy Quiggle. *Ind. Eng. Chem.*, **42** (1950), pp. 649-53.

Various mixtures have been studied or proposed for determining the efficiencies of fractionating columns at reduced pressures. The desirable characteristics of such mixtures are stated. The authors present vapor-liquid equilibrium data, obtained in a unit having the equivalent of two theoretical plates for the binary system n-decane-trans-Decalin, or decahydronaphthalene. The data cover the range of 50 mm. absolute pressure to atmospheric pressure. The relative volatility, alpha, of this system is constant over the composition range at any given pressure. The relative volatility increases from 1.19 at 50 mm. to 1.30 at atmospheric pressure and makes possible the testing of columns having the equivalent of 34 and 22 theoretical plates at the two pressures, respectively. Some other test mixtures are discussed.

Purification of and the Determination of the Physical Properties of Hydrocarbons. R. A. Lowry. *Jour. Inst. of Petroleum*, **36** (1950), pp. 80-8.

The paper deals with the purification and characterization of hydrocarbons. Fractionation in high efficiency columns is the most important tool available for hydrocarbon purification. The most satisfactory method for removing traces of oxygenated compounds or olefins is to pass the hydrocarbon over an adsorbent such as activated silica gel. It is advisable to adopt this procedure for all saturated hydrocarbons before subjecting them to fractionation. The application of azeotropic and extractive distillation is considered. In some instances fractional crystallization is an important method of purification. The importance of the freezing point as a means of detecting impurities is discussed.

Stability of Burner Flames with Propane-Hydrogen Mixtures. S. H. Reiter and C. C. Wright. *Ind. Eng. Chem.*, **42** (1950), pp. 691-4.

The work reported was undertaken to determine whether the velocity gradient concept is applicable to binary mixtures and also to furnish the basis for later studies on multicomponent gases. Mixtures of hydrogen and propane were chosen because data are available on these gases separately, and further because of their marked difference in burning velocity and flame stability properties. Blowoff and flash-back data are reported for propane, hydrogen, and mixtures of the two gases. The results obtained in the region of laminar flow using air-cooled burner tubes can be correlated in terms of velocity gradients at the burner wall. The effect on blowoff and flash back of increasing concentrations of hydrogen in hydrogen-propane mixtures is shown to be nonlinear for both phenomena.

Manufacture: Processes and Plant

Status of Thermodynamics in the Petroleum Industry. B. H. Sage. *Ind. Eng. Chem.*, **42** (1950), pp. 631-9.

Cyclic Polyolefins. IV. 1,3-Cyclooctа-

The importance of thermodynamics in the engineering activities associated with the petroleum industry is well recognized today. Its primary utility relates to the prediction of the heat and work associated with changes in state and with the

estimation of the chemical potential of a phase as a function of state. The basic relationships of typical calculations are presented by the author together with a brief consideration of the means of obtaining thermodynamic properties of petroleum compounds and their mixtures from known data. The status of measurements of the properties of the lighter paraffin hydrocarbons is given and the fields in which further experimental work can be advantageously done are briefly considered. The author presents an extensive bibliography of 274 references.

Hydrodynamics of Liquid-Vapor Flow in Packed Distillation Columns. T. M. Reed III and M. R. Fenske. *Ind. Eng. Chem.*, **42**, (1950), pp. 654-60.

A relationship is given that correlates variables, such as packing dimensions, phase properties, and operating conditions, in the flow of vapor and liquid through packed distillation columns. The data obtained from the operation of columns packed with single-turn helices correlate well by the relation given. Other types of laboratory distillation column packings follow approximately the same correlation. A simplified form of the general equation is given and uses for its are suggested. The effects of vapor density on pressure drop, operating pressure on throughput, and phase densities on the flooding points are discussed. The value of the exponent n in the expression $p = kG^n$ is examined and it is shown that value of n often found experimentally are greater than the usual turbulent maximum of 2 and are consistent with and required by conditions under which a distillation column operates. The data are presented in some detail in tabular and graphical form and a bibliography of 13 references is included.

Rapid Routine Calculation of Multicomponent Mixtures with Punched Card Machines. Ascher Opler. *Analytical Chem.*, **22** (1950), pp. 558-60.

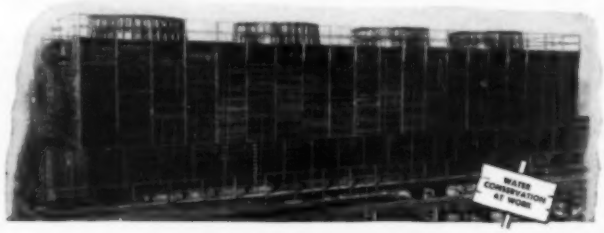
To facilitate rapid routine determination of 10 component samples, multicomponent analysis was performed on an infrared spectrometer. The enormous task of calculating hundreds of samples was handled by punched card machines using standard accounting office equipment. A time of three minutes per sample was required. The limits to the accuracy of the method are discussed.

Limiting Flows in Packed Extraction Columns. R. R. Breckenfeld and C. R. Wilke. *Chem. Eng. Progress*, **46** (1950), pp. 187-94.

Liquid-liquid extraction in packed columns involves the countercurrent flow of two immiscible liquids. For a given flow rate of one phase in a given column there will be some maximum flow rate for the other phase which, if exceeded, will result in accumulation in the column and cause ultimate failure of column operation. A knowledge of limiting flows or flooding velocities is essential to column design. Unfortunately, the subject has received little attention so that few data and no general correlations are presently available for prediction of column capacity. The authors briefly review the literature of the subject. The experimental column used by them is described. Eight systems were investigated, seven in a system using ¼-inch Raschig rings and one in a column using ½-inch Berl saddles. A correlation of the data is presented which the authors believe is in satisfactory agreement with available data on limiting flows in packed extraction columns. It is cautioned, however, that the correlation must be used carefully when considering systems markedly different from those on which its development is based. A bibliography of 10 references is included.

Mass-Transfer Resistances In Liquid-Liquid Extraction. G. S. Laddha and J. M. Smith. *Chem. Eng. Progress*, **46** (1950), pp. 195-202.

Liquid-liquid extraction has achieved an increasingly important position as a separation process, particularly in the manufacture of organic chemicals. The purpose of the investigation reported was the determination of height of transfer unit (h.t.u.) and values for individual films for two systems of components, namely, isobutyraldehyde-water and 3-pentanol-water. The 2-inch i.d. column was operated in three ways: 1) as a spray column, 2) packed with ¼-inch Raschig rings, and 3) packed with ¾-inch Raschig rings. The h.t.u. of the discontinuous phase was found to be nearly independent of variations in the flow rate of both phases, and of the three types of column operation. The h.t.u. of the continuous phase was affected by both flow rates, but could be correlated with the ratio of the flow rate of the



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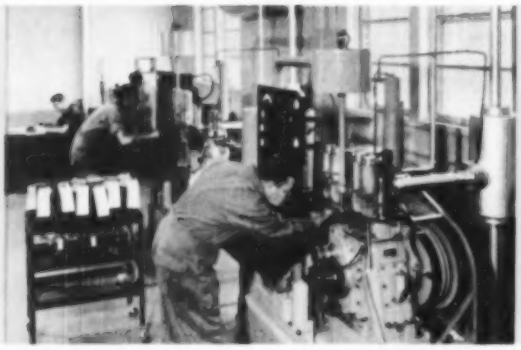

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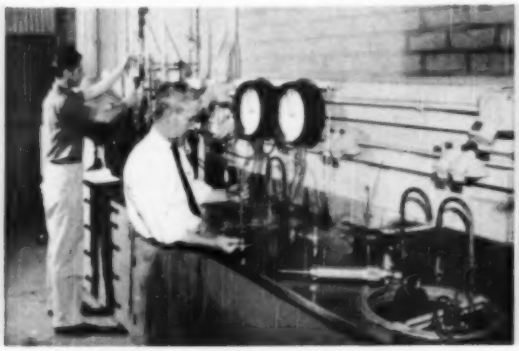

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continuous phase to the discontinuous phase by an equation that is given. A bibliography of 12 references is included.

Platinum Reforming of Gasoline. MERRITT L. KASTENS AND ROBERT SUTHERLAND. *Ind. Eng. Chem.*, **42** (1950), pp. 582-93.

The platinum reforming process described was developed to improve the octane rating of straight run or natural gasolines. The process combines the conversion of naphthenes to aromatics, the hydrocracking of paraffins, the isomerization of paraffins, and virtually complete desulfurization in a single nonregenerative catalytic process. The paper described the first commercial unit of this type built at the plant of the Old Dutch Refining Company at Muskegon, Mich. The preparation of the charging stock, the reforming operations and the stabilization of the product are described. The success of the process is the result of the development of a catalyst that will promote the desired reaction while depressing carbon formation. Operations for four months in the commercial plant have resulted in no measureable decrease in catalyst activity. The plant has been operated to produce gasolines with a leaded octane value of 93. Yields have averaged 94.5 percent by volume under this operating condition. For a period of several weeks the plant was operated to produce a product having a leaded octane number of 95.8 and gave a yield of 92 volume percent. Capital and operating costs are given, the operating cost ranging from 30 to 37 cents per barrel of reactor charge.

Silica-Magnesia Cracking Catalyst. Commercial Performance. A. L. CONN, W. F. MEEHAN, AND R. V. SHANKLAND. *Chem. Eng. Progress*, **46** (1950), pp. 176-86.

Prior to May, 1948, only two types of catalysts had been employed in commercial fluid-catalyst cracking units, that is, silica-alumina catalyst and acid-treated montmorillonite clay. However, other catalysts are now being made and one of these is the synthetic silica-magnesia catalyst. The authors report on a 315-day period of use of this catalyst in a 25,000 barrels per day unit. Higher gasoline yields, lower butane and gas yields, and lower octane numbers were obtained compared with silica-alumina. Although the silica-magnesia catalyst showed the anticipated high activity maintenance and immunity to sulfur poisoning, it also showed an unfavorable trend toward decreased regeneration efficiency. This ultimately resulted in the termination of the operation. Further work is being done to determine the causes and possible cure for the low regeneration efficiency. The makeup requirement was found to be only about two-thirds of that normal to silica-alumina catalyst. It was possible to operate with high carbon on the catalyst without the uncontrolled coke building and excessive catalyst losses that are characteristic of silica-alumina catalyst. A bibliography of 11 references is included.

Decolorization of Tallow by Liquid-Liquid Extration with Propane. E. B. MOORE. *J. Am. Oil Chemists' Soc.*, **27** (1950), pp. 75-80.

The liquid-liquid extraction of glycerides using propane as a solvent is now practiced commercially. Colored contaminants of the tallow are removed as an extract and the decolorized tallow as a raffinate in propane solution. The range of working temperature lies between 150 and 170° F. The results are very sensitive to temperature. Contrary to what might be expected, it is found that the solubility of tallow in propane decreases as tower temperature increases. The higher the solvent ratio, the better the color of the tallow. Decolorization of tallow by liquid-liquid extraction with propane constitutes an important technical advance in the treatment of tallows. The procedure is more effective than the use of bleaching earths and chemical bleaches.

Grease Plant and Packaging Center. J. V. HIGHTOWER. *Chem. Eng.*, **57** (1950), pp. 116-19.

The grease plant and the packaging installation of the Standard Oil of California at Richmond is described. A building covering 7½ acres is the refinery's centralized point for the final processing, packaging and shipment of compounded lubricants, greases and specialties. Packages range from 4-ounce containers to 55-gallon steel drums. The building houses equipment for the making of soaps used in greases, facilities for both batch and continuous grease making, manufacture of compounded oils and specialties, storage of raw materials, units for filling containers with products manufactured inside and outside the building, an extensive system of conveyors to shipping stations, warehouse sec-

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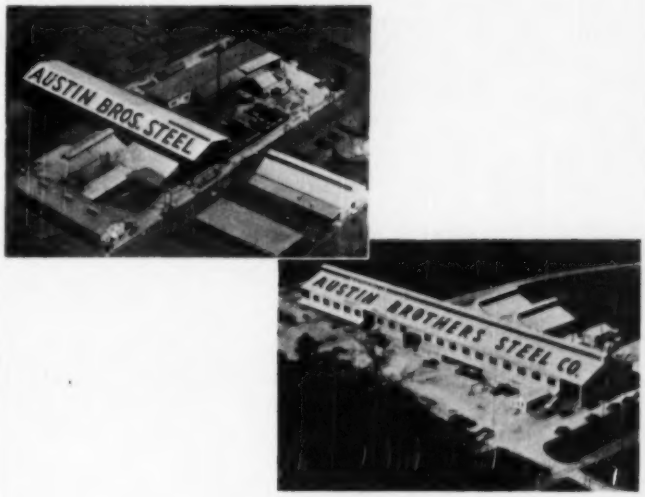

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Separation of Oil Refinery Waste Waters. Roy F. Weston. *Ind. Eng. Chem.*, **42** (1950), pp. 607-12.

The economical and sufficient separation of oil from waste waters is a problem of importance in every refinery. The problem is that of the separation, collection, and reconditioning of the oil for recharging to refinery processes, and the production of a waste water satisfactory for disposal. Oil is separated from waste water by gravity differential-type separators. An analytical procedure is described to determine the ease of separation. By use of this it is possible to determine the nonseparable oil content of a sample. Efficiencies of the various separators used are given. Oil so separated contains suspended solids and water, and these may interfere with efficient processing. It is necessary to treat these slop oils prior to recharging to refinery equipment and typical data are given on the characteristics of the slop oil treatment. Operating data are presented for an automatic backwash sand filter that is successfully "polishing" a separator effluent. Pilot plant studies using biological filters indicate general improvement of separator effluents including substantial reductions in oil content. Although no nutrient materials are added to these oil filters, the efficiencies obtained are comparable with those from sewage-treatment filters. It is interesting to note that the oil removal efficiencies are of the same order of magnitude as those for B.O.D. The sludge accumulating in the effluent settling tank contains oil equivalent to about 31 percent of the oil-free solids content. A bibliography of 6 references is included.

Products: Properties, Utilization and Analysis

Improved Equipment for Engler-Type Distillations. Internal Electric Heater. H. B. H Cooper and E. C. Meikalf. *Analytical Chem.*, **22** (1950), pp. 587-90.

To minimize fire hazard and improve the laboratory efficiency of the distillation tests, an internal type of electric immersion heater was developed and is described. Good agreement betwen the results of using this heater and external gas heating was had. Uniformity of vaporization and the exactness of adjustment assure reproducibility of results. A modified distillation apparatus was found useful with petroleum products.

Water Content of Hydrocarbons. Modified Karl Fischer Method. W. S. Hanna and A. B. Johnson. *Analytical Chem.*, **22** (1950), pp. 555-8.

Methods for the determination of water in hydrocarbons are briefly reviewed, including both physical and chemical methods. Of these the Karl Fischer method is by far the most widely used because of its greater accuracy in the determination of water over the range 0.0005 to 0.5 percent. However, there are certain difficulties in the application of this reagent to hydrocarbons. The authors describe a modification of the method involving the extraction of water from the hydrocarbons by dry ethylene glycol and the subsequent titration of the glycol extract with Fischer reagent. Ninety percent of the water present is adsorbed in one extraction. The method is flexible in that, when properly used, equally accurate determinations can be made on very dry or relatively very wet stocks. Increased accuracy with stocks of low water content can be obtained by concentrating the water from a large volume of hydrocarbon into a small volume of extract. The method can be applied to high vapor pressure stocks such as liquefied petroleum gases, and also to colored stocks, such as lubricating oils, transformer oils, etc., where the colored substances are not soluble in glycol. A bibliography of 28 references is included.

Determination of Saturated and Aromatic Constituents in Spindle Distillates and Derived Products By Adsorption Fractionation. G. H. Beaven, L. F. Foster, and C. N. Thompson. *Jour. Inst. of Petroleum*, **36** (1950), pp. 89-104.

A method was developed for the quantitative separation of the aromatic and saturated compounds in petroleum products in the spindle-oil viscosity range. Separation was based on the relative adsorptive tendencies of the oil components for activated silica gel. The procedure is especially valuable in exploratory work when little is known about the relative proportions and properties of the two main groups of components. It has also been found useful in the analysis of low aromatic oils for which other methods are less suitable. The aromatic content which is defined as the percentage by weight of compounds containing the aromatic rings, is determined to within ± 2 percent. A bibliography of 7 references is included.

Evaporation of Solvents and Thinners. Thin Film Evaporation vs. Evaporation of Bulk Liquids and Instruments for Their Measurement. Ralph J. Curtis, James R. Scheible, and Theodore F. Bradley. *Analytical Chem.*, **22** (1950), pp. 538-45.

There has never been a widely accepted method for measuring the evaporation rates of solvents and thinners, nor has the ASTM approved any of the previously described methods as a standard ASTM procedure. The authors review the various methods that have been proposed and used and have devised new equipment which is being made generally available. The details of this equipment and its use for a variety of applications are presented. The work done shows that atmospheric humidity, the nature of the surfaces from which liquids are permitted to evaporate, and the chemical components of solvents and solutes are significant factors that often assume greater importance in thin-film evaporation than in the evaporation of bulk liquids. The authors express the hope that the work done will assist in the much needed standardization of evaporation rate measurements and in the reporting of such data. The apparatus is described in some detail and typical results are presented.

Chemical Composition and Reactions

Some General Considerations of Hydrocarbon Synthesis. C. R. Porter. *Jour. Inst. of Petroleum*, **36** (1950), pp. 61-7.

The paper is one of several of a symposium covering the work of the Hydrocarbons Synthesis Panel. It describes several general considerations that have influenced hydrocarbon synthesis as conducted by the panel. The aim was to secure substances as pure as possible and by methods that left no reasonable doubt as to the structure of the substances obtained. Intermediate products in the syntheses were themselves rigorously purified. Methods of purification included fractional distillation, adsorption and crystallization. Frequently derivatives were made that could be purified and later reconverted to the original substance under mild conditions. In general the organic reactions were chosen so that as far as possible the molecular structure of the product could be predicted.

Branched Chain Hydrocarbons, Their Synthesis and Reactions. W. J. Hickinbottom. *Jour. Inst. of Petroleum*, **36** (1950), pp. 67-70.

The object of the work reported was to develop methods for the synthesis of hydrocarbons with a repeating pattern of quaternary carbon atoms and side chains. The standard method of preparing such hydrocarbons makes use of zinc dialkyls or other organo-metal compounds with tertiary alkyl halides. This, however, proved to be of restricted application to the present problem, and it became necessary to develop other methods. The Grignard reaction was applied in many cases. A second major scheme of synthesis now under study is concerned with developing methods for inserting a quaternary carbon atom into a molecule already having one or more such atoms.

The Synthesis of 2:3:5-Trimethylhexane and of 2:4:6-Trimethylheptane. H. J. Shine and E. E. Turner. *Jour. Inst. of Petroleum*, **36** (1950), pp. 70-3.

The synthesis of 2:3:5-trimethylhexane and 2:4:6-trimethylheptane is described. Three different preparations were used to make each of these hydrocarbons. However, four of the syntheses were regarded as impractical because of difficulties in manipulation or of low yields.

Thermal Decomposition of Paraffin Hydrocarbons. The Kinetics of the Thermal Decomposition of Normal Paraffin Hydrocarbons. I. The Inhibition of Chains and the Nature of the Residual Reaction. F. J. Stubbs and Sir Cyril Hinshelwood. *Proc. Roy. Soc.*, **200**, Series A, (1950), pp. 458-73.

The thermal decomposition of a normal saturated paraffin yields a short chain paraffin with a long chain olefin, or a long chain olefin may decompose to give two olefins. Either of these reactions can be considered as a direct molecular rearrangement. On the other hand, a chain mechanism can be imagined leading to identical products. The authors study the inhibition of the reaction by nitric oxide and by propylene. They conclude that the reaction observable when the rate has been reduced to its lowest value by nitric oxide is that of a molecular decomposition of the hydrocarbon.

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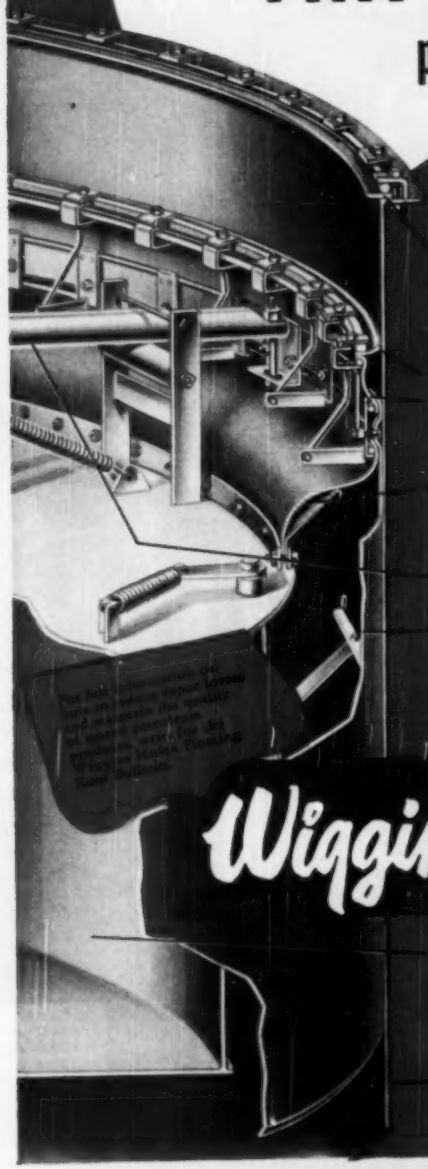

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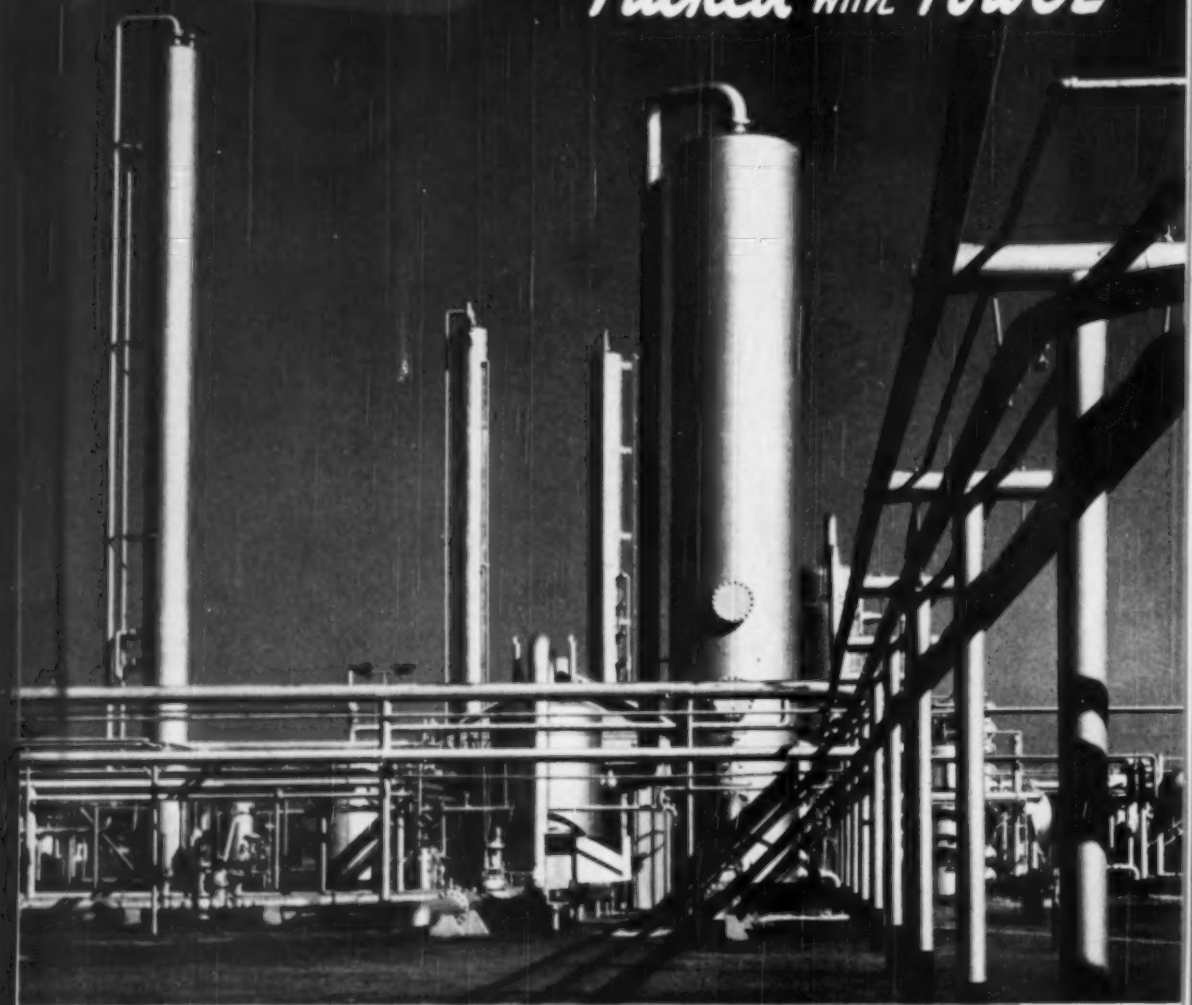

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(From the Official Gazette, March 14, 21, 28 and April 4, 11, 1950)

REFINING

U.S.P. 2,500,349. Process for Breaking Petroleum Emulsions. M. DeGroote and B. Keiser to Petrolite Corporation, Ltd.

A hydrophile, hydroxy-polyalkoxy compound is employed for breaking petroleum emulsions of the water-in-oil type. The said compound is obtained by the action of an alkylene oxide containing a reactive ethylene oxide ring and having not over 4 C atoms on a stearic acid partial ester of pentaerythritol or a polypentaerythritol, or mixture thereof.

U.S.P. 2,500,353. Process for Fractionally Separating a Mixture of Normally Gaseous Components. J. E. Gantt to Universal Oil Products Company.

Details are claimed of a process for fractionally separating a mixture of normally gaseous components of different boiling points, e.g., a mixture comprising C_4 hydrocarbons and lower boiling components by partial liquefaction and solution at low temperatures, purification of selected gas fractions, and low-temperature fractionation.

U.S.P. 2,500,736. Method of Separating a Diolefin from a Mono-olefin L. K. Beach to Standard Oil Development Company.

A mixture of a diolefin and a mono-olefin is separated by contacting the mixture with a liquid phenolic compound in the presence of H_2SO_4 or a sulfonic acid catalyst at a temperature of 50-250° C. The diolefin is reacted with the phenolic compound, while the mono-olefin remains unreacted and is separated in gaseous phase from the reaction mixture.

U.S.P. 2,500,757. Removal of Asphaltic Constituents from Hydrocarbon Oil. W. Kiersted Jr. to Texaco Development Company.

Details are claimed of a continuous method of separating asphaltic and resinous constituents from residual lubricating oil stock by treatment with a liquefied normally gaseous C_4 or higher hydrocarbon solvent in a series of stages.

U.S.P. 2,500,916. Method and Apparatus for Controlling Vaporization. T. H. Whaley Jr. to Phillips Petroleum Company.

Details are claimed for the separation of a hydrocarbon well effluent under variable temperature conditions into a liquid fraction and a plurality of gaseous fractions. The vapor pressure of the liquid product is controlled by control of the quantity of vapor removed from the liquid.

U.S.P. 2,501,015. Process for Breaking Petroleum Emulsions. A. F. Wirtel to Petrolite Corporation, Ltd.

A process is claimed for breaking petroleum emulsions of the water-in-oil type by means of a mechanical mixture of four different ingredients, viz., an alkali metal petroleum sulfonate, an ammonium salt of propylated naphthalene monosulfonic acid, a cyclohexylamine salt of such acid, and an oxyethylated thermoplastic phenol-aldehyde resin of specific constitution.

U.S.P. 2,501,115. Separation of Hydrocarbon Synthesis Products. P. C. White to Standard Oil Company (Indiana).

The vaporous mixture of hydrocarbons and oxygenated compounds obtained in a Fischer-Tropsch synthesis is partially condensed. A liquid water phase including condensible organic oxygenated compounds, a liquid hydrocarbon phase, and a rich gas phase are separated. By stripping and treating the various phases with absorber oil, the hydrocarbons are separated from the organic oxygen compounds.

U.S.P. 2,501,124. Jet Combustion Fuel. D. P. Heath to Socony-Vacuum Oil Company, Inc.

A distillate hydrocarbon petroleum oil boiling within the range of light gasoline to heavy gas oil is compounded with 0.1-2 percent by weight of thiophene. The liquid fuel formed is utilizable in jet combustion mechanisms. The additive reduces deposits in the combustion chamber.

U.S.P. 2,501,153. Shale Oil Eduction. C. H. O. Berg to Union Oil Company of California.

In the recovery of oil from shale, the shale is introduced through a liquid sealing medium into the lower portion of a treating zone and is preheated and subsequently educted while passing upwardly through this zone. The resulting carbonaceous shale is contacted with an oxygen-containing gas to induce combustion of the carbonaceous materials. The educted materials obtained are further treated to recover liquid oil from shale fines formed.

U.S.P. 2,501,602. Refining Highly Aromatic Petroleum Stocks. H. D. Hartough and D. E. Badertscher to Socony-Vacuum Oil Company, Inc.

A highly aromatic petroleum stock as obtained as bottoms in the catalytic cracking of petroleum containing polycyclic aromatic hydrocarbons is reacted with formaldehyde and ammonium chloride. A light colored stock of improved color stability is obtained from the water washed reaction mixture.

U.S.P. 2,503,014. Method for Resolving Emulsions. W. O. Webber to Standard Oil Development Company.

An emulsion of a mineral oil and water is intimately mixed with 2-45 percent of finely divided wood particles of an average diameter of 0.002-0.5 inch. The average density shall be substantially equal to the specific gravity of the emulsion. These wood particles having the property of resolving the emulsion, at least two phases are formed on settling, each of which phases comprises as a major component one of the constituents of the emulsion.

U.S.P. 2,503,119. Solvent Extraction. A. C. McKinnis to Union Oil Company of California.

Hydrocarbon is separated from its mixture with an organic nitrite, as obtained for example in the azeotropic distillation of a C_4-hydrocarbon fraction with methyl nitrite, by extracting the mixture with a solvent for the nitrite consisting of a saturated polar oxygenated organic compound other than this nitrite, e.g. a saturated alcohol, and having a b.p. other than the latter, and containing a dissolved alkali or alkaline earth metal salt. The extracted organic nitrite is removed from the solvent-salt solution.

U.S.P. 2,503,977. Desalting Crude Petroleum. P. S. Viles to Standard Oil Development Company.

Inorganic salts and brine are removed from crude petroleum by first separating the brine from the petroleum by gravity and then heating the remaining crude petroleum to a temperature of 100-400° F. The heated petroleum, freed, if required, from additional amounts of brine by gravity, is contacted with a bed of $CaCl_2$ or other alkaline earth metal halide at a pressure sufficient to maintain a liquid phase. Desalted crude petroleum is removed from the bed.

U.S.P. 2,504,019. Treatment of Oil-in-Water Emulsions. I. D. Hall to Standard Oil Development Company.

For breaking an oil-in-water emulsion, its pH is adjusted to no more than 6 and it is then admixed in at least equal amounts with a hydrocarbon having 3-7

C atoms to cause phase separation. The hydrocarbon phase formed is separated from the water phase.

CRACKING AND REFORMING

U.S.P. 2,500,870. Hydrocarbon Cracking Process and Apparatus Using Pebble Heater with Jet Ejector. S. P. Robinson to Phillips Petroleum Company.

Details are claimed of a process and an apparatus for uniformly cracking hydrocarbon vapors in the presence of hot pebbles and for improving the yield of olefins and acetylenes.

U.S.P. 2,503,188. Apparatus for Thermal Cracking of Hydrocarbons. E. V. Bergstrom to Socony-Vacuum Oil Company, Inc.

Details are claimed of an apparatus for thermal cracking of hydrocarbons at high temperature for short periods, or for their catalytic cracking. A highly heated refractory solid is continuously passed into and through the reactor to heat the hydrocarbon charge to reaction temperature and maintain it at this temperature for a predetermined period of time.

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U.S.P. 2,503,202. Contacting Apparatus. G. L. Johnson, J. Happel, and J. W. McKee to Socony-Vacuum Oil Company, Inc.

Details are claimed of an apparatus for the thermal cracking of hydrocarbons by contact with a highly heated solid material and in the presence of steam. The reactant fluids are preheated in contact with the solids, preferably with vaporization of the hydrocarbons and the water from the liquid state.

ISOMERIZATION

U.S.P. 2,501,071. Isomerization of Hydrocarbons. J. M. Mavity to Universal Oil Products Company.

Low boiling hydrocarbon material is contacted with a bed of solid anhydrous sludge-forming metal halide catalyst of the Friedel-Crafts type under conversion conditions. An active metal halide sludge produced concomitantly with the conversion is withdrawn from the bed. Hydrocarbons from the contacting step are contacted with this sludge for further conversion, utilizing the catalytic activity of the sludge. The process is particularly useful in the isomerization of hydrocarbons.

U.S.P. 2,502,008. Use of Mobile Catalysts in the Isomerization of Hydrocarbons. T. B. Hudson and J. D. Upham to Phillips Petroleum Company.

In the isomerization of saturated hydrocarbons, a mobile catalyst, immiscible with the hydrocarbons, is passed through the reaction zone countercurrent to the hydrocarbons and introduced into this zone at a plurality of points. The total catalyst activity is thus controlled in the direction of the hydrocarbon flow.

U.S.P. 2,502,565. Isomerization Process. J. Hoekstra to Universal Oil Products Company.

Thermally cracked gasoline is subjected at a temperature of 800-1100° F. and an hourly weight space velocity of 5-50 to the action of a catalyst comprising magnesium chromate, silica and alumina, zirconia, or magnesia. The octane number of the gasoline is increased by isomerization of olefins contained therein.

ALKYLATION

U.S.P. 2,500,369. Process for the Preparation of Ditolylethane. J. A. McCoubrey and F. P. Lossing to Shawinigan Chemicals, Ltd.

In the preparation of 1,1-di-p-tolylethane, there is added to a mixture of toluene and H_2SO_4 of 87-93 percent strength a mixture of toluene and paraldehyde while maintaining a temperature below 10° C. The total amount of the toluene employed shall be more than 25 percent in excess of that theoretically required for the reaction with the paraldehyde. The amount of H_2SO_4 shall be such that its strength is not decreased below 87 percent by the water formed.

U.S.P. 2,501,625. Methylation of Isoparaffins in the Presence of Hydrogen Fluoride. R. E. Woodward to Socony-Vacuum Oil Company, Inc.

An isoparaffin is reacted with a methyl halide in the presence of a HF catalyst. The isoparaffins are methylated pre-

dominantly at the terminal C atoms.

U.S.P. 2,502,000. Alkylation of Aromatic Hydrocarbons. C. F. Feasley to Socony-Vacuum Oil Company, Inc.

An aromatic hydrocarbon is contacted at a temperature of 300-800° F. with a tertiary or ditertiary aliphatic monosulfide in the presence of an alkylation catalyst of the silica-alumina type, e.g., a synthetic adsorbent composite of silica and alumina or at least one other amphoteric metal oxide. Tertiary alkyl benzenes, and the like, are produced.

U.S.P. 2,502,001. Alkylation of Aromatic Hydrocarbons with Tertiary Aliphatic Mercaptans. C. F. Feasley to Socony-Vacuum Oil Company, Inc.

The process of this patent is closely related to that of U.S.P. 2,502,000. Tertiary aliphatic mercaptans are here employed as the alkylating agents at a temperature of 140-700° F.

U.S.P. 2,502,015. Method of Alkylating Isoparaffins with 2-Olefins. M. P. Matuszak to Phillips Petroleum Company.

In the production of a motor fuel from an isoparaffin and a mixture of 1- and 2-olefins in which the 1-olefin is at least in part isomerized by a liquid isomerization catalyst and the isoparaffin is alkylated with the 2-olefin in the presence of concentrated HF, the liquid isomerization catalyst is aqueous HF with a content of 50-80 percent HF by weight.

U.S.P. 2,502,333. Preheated Charge in Hydrogen Fluoride Alkylation. J. R. Meadow and A. A. O'Kelly to Socony-Vacuum Oil Company, Inc.

In the catalytic alkylation of isoparaffins with olefins, a charge mixture of isoparaffin and olefin is introduced at a temperature of 150-300° F. to a body of liquid HF maintained at a temperature below 100° F.

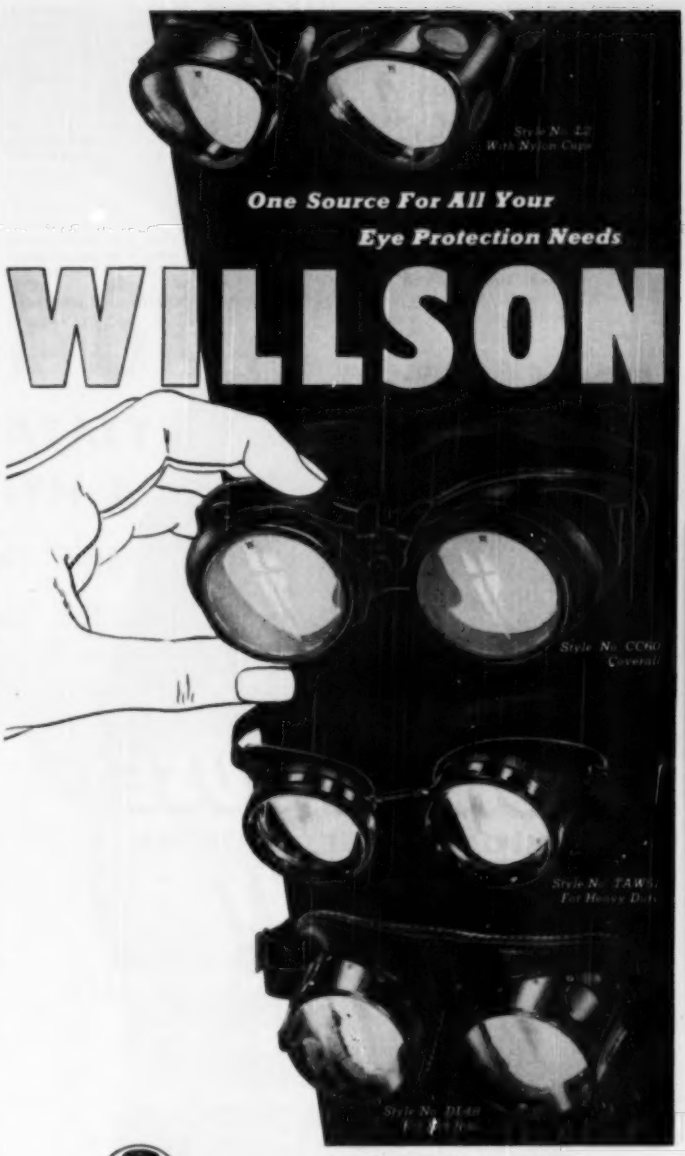
POLYMERIZATION AND CONVERSION

U.S.P. 2,500,159. Synthetic Lubricants. H. G. Doherty, A. N. Sachanen, and F. M. Seger to Socony-Vacuum Oil Company, Inc.

A charge consisting essentially of a normal, alpha mono-olefin with 6-14 C atoms is subjected to a temperature of 700-900° F. for periods of about 10 hours to 1 hour, respectively, and in the presence of H_2, CO, or mixtures thereof at a partial pressure of the gas employed of 50-5000 psi. Lubricants with high viscosity indices, low pour points, and good stability are produced.

U.S.P. 2,500,160. Synthetic Lubricants. F. M. Seger and A. N. Sachanen to Socony-Vacuum Oil Company, Inc.

A charge consisting essentially of a straight chain normal alpha mono-olefin with 5-12 C atoms and styrene is heated in the absence of a catalyst at a temperature of 500-700° F. for 10 hours to 1 hour, respectively. The molar proportion of the alpha mono-olefin in the charge shall be substantially greater than that of styrene. Lubricating oils having a viscosity index of at least 100 and



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low pour point are obtained.

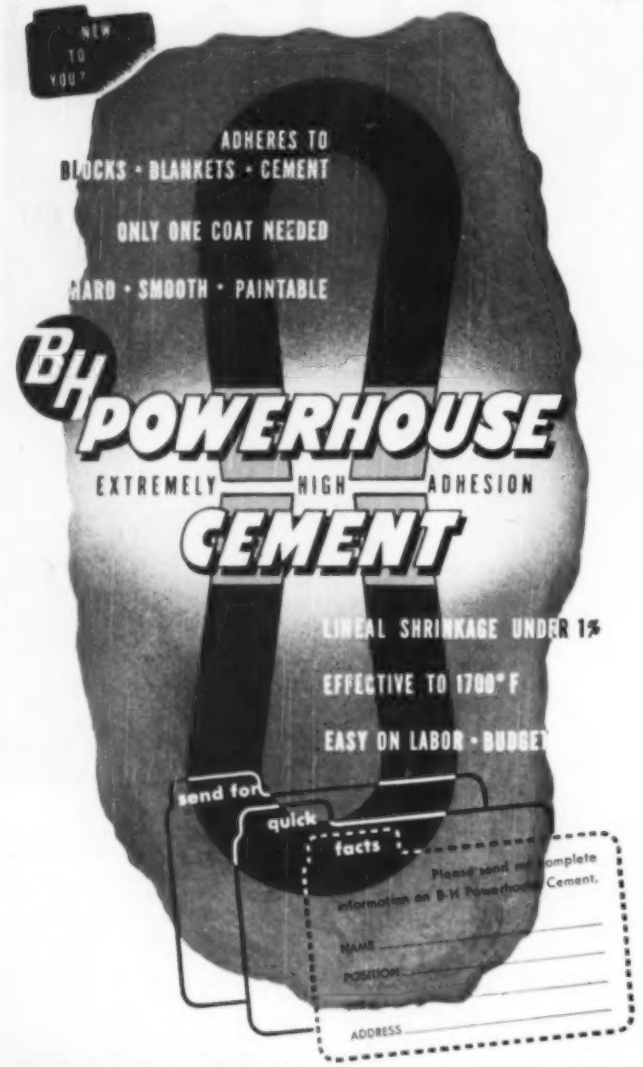
U.S.P. 2,500,161. Conversion of 1-Olefins in the Presence of Lead Tetra-Acetate. F. M. Seger and A. N. Sachanen to Socony-Vacuum Oil Company, Inc.

A mono-olefin of the type employed according to U.S.P. 2,500,160 is heated with lead tetra-acetate at a temperature of 400-700° F. for 10 hours to 1 hour, respectively, under a pressure sufficient to maintain the olefin in substantially liquid phase. A viscous oil of high viscosity index and low pour point is produced.

U.S.P. 2,500,162. Method of Preparing Viscous Oils by the Thermal Condensation of Short Chain Mono-Olefins with Long Chain Mono-Olefins. F. M. Seger and A. N. Sachanen to Socony-Vacuum Oil Company, Inc.

An olefin mixture consisting essentially of a short chain mono-olefin with 2-6 C atoms and a long Chain normal, alpha-mono-olefin with 10-30 C atoms is non-catalytically condensed at a temperature of 500-700° F. for 20 hours to 1 hour, respectively. The two types of olefins employed in mixture shall be in such molar proportions that the mean value of the olefin chain length in the mixture is 6-12 C atoms. A viscous oil is obtained.

U.S.P. 2,500,163. Synthetic Lubricants. W. E. Garwood to Socony-Vacuum Oil Company, Inc.



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A normal alpha mono-olefin having 5-18 C atoms is polymerized at a temperature of 600-750° F. with a phosphorous sulfide, elemental phosphorous with elemental sulfur, or mixtures thereof. The amount of this additive shall be less than 1 percent by weight of the reaction mixture. Viscous oil is produced.

U.S.P. 2,500,164. Synthetic Lubricant. W. E. Garwood, F. M. Seger and A. N. Sachanen to Socony-Vacuum Oil Company, Inc.

A normal alpha mono-olefin with 6-14 C atoms is polymerized at a temperature of 550-750° F. for 20 hours to 1 hour, respectively, in the presence of elementary S, Se, or Te in an amount of 0.01-0.15 mol per mol of olefin. A viscous oil is prepared.

U.S.P. 2,500,165. Synthetic Lubricants. H. G. Doherty, A. N. Sachanen, and F. M. Seger to Socony-Vacuum Oil Company, Inc.

A charge consisting essentially of a normal alpha mono-olefin with 6-14 C atoms is heated in the absence of catalysts and in the presence of a minor amount of a paraffin at a temperature greater than 700° F. for 3 hours to 1 hour, or at less than 900° F. for 1.5-.25 hours. A viscous oil is obtained.

U.S.P. 2,500,166. Synthetic Lubricants. F. M. Seger and A. N. Sachanen to Socony-Vacuum Oil Company, Inc.

A viscous oil is obtained by heating a normal alpha mono-olefin with 6-12 C atoms at a temperature of 600-750° F. for 20 hours to 1 hour, respectively.

U.S.P. 2,500,167. Lubricant Composition. W. E. Garwood, F. M. Seger, and A. N. Sachanen to Socony-Vacuum Oil Company, Inc.

One mol proportion of a straight chain alpha mono-olefin with 5-18 C atoms is condensed with 0.01-1 mol proportion of certain conjugated hydrocarbons or dienes and 0.001-1 mol proportions of S, Se, or Te at a temperature of 400-750° F. for 10 hours to 1 hour, respectively. A viscous oil is produced.

U.S.P. 2,500,203. Synthetic Lubricants. O. M. Reiff, H. J. Andress Jr. and A. P. Kozacik to Socony-Vacuum Oil Company, Inc.

A viscous oil of low pour point and low cloud point is prepared by heating a mixture of 2 mol proportions of a mono-olefin with 8-18 C atoms and 1 mol proportions of a vinyl aromatic compound in the presence of a silica-amphoteric metal oxide catalyst at a temperature of 300-600° F. to effect condensation.

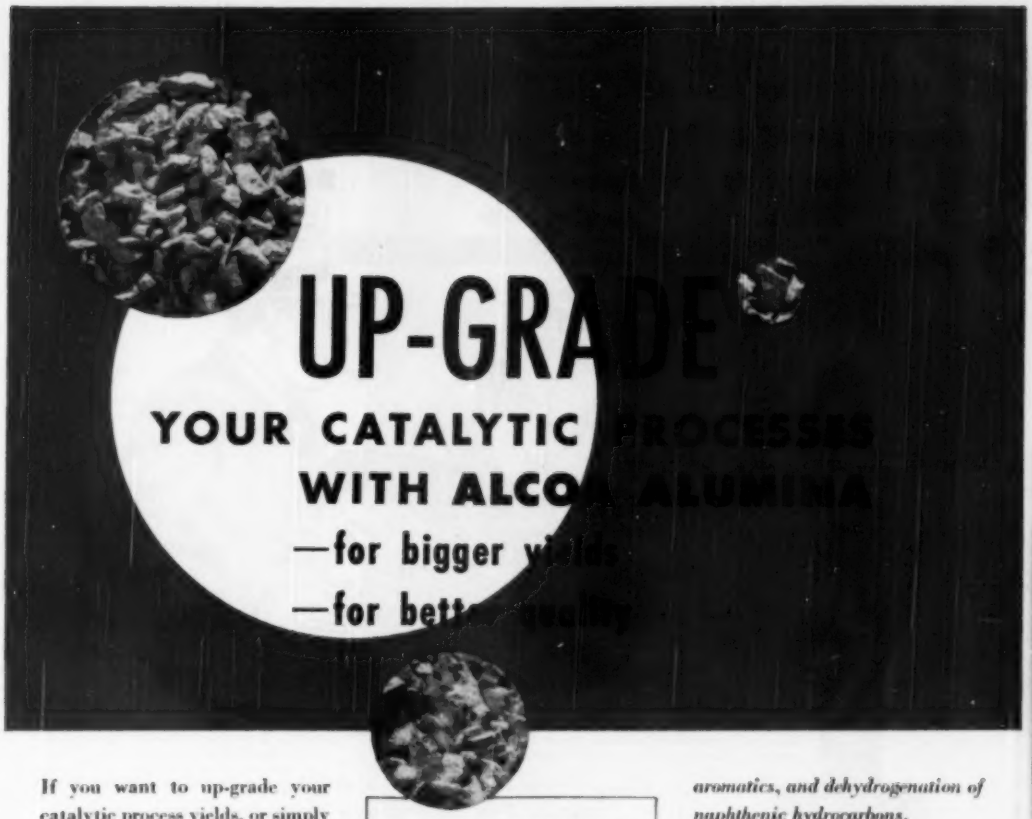
U.S.P. 2,500,244. Polymerization of Alpha Olefins. H. G. Doherty to Socony-Vacuum Oil Company, Inc.

A normal alpha mono-olefin with 6-14 C atoms is heated in the presence of a minor amount of a cyclic hydrocarbon at a temperature greater than 700° F. for 1-3 hours, or at less than 900° F. for ½-¼ hour. A viscous oil is obtained.

U.S.P. 2,500,235. Pyrolytic Conversion of Hydrocarbons. L. H. Beckberger to Sinclair Refining Company.

Details are claimed of an apparatus for the conversion of hydrocarbons with regeneration of spent catalyst.

U.S.P. 2,500,247. Synthetic Lubricants. W. E. Garwood, F. M. Seger, and A. N. Sachanen to Socony-Vacuum Oil



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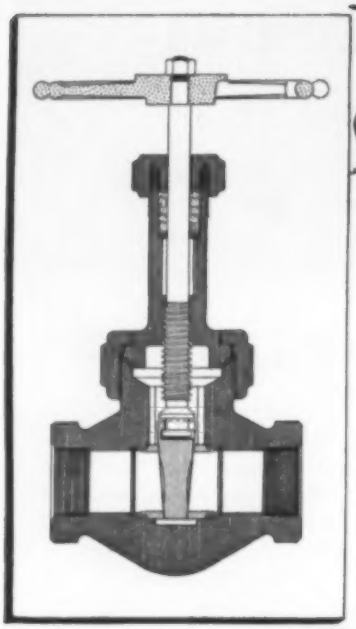

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The process of this patent is closely related to that of U. S. patent 2,500,167. A phosphorous sulfide, a mixture of elemental P and S, or mixtures of both are here employed instead of S, Te, or Se.

U.S.P. 2,500,307. Aliphatic Olefins and Cyclic Process for Manufacture Thereof. L. F. Brooke, W. E. Elwell, and R. L. Meier to California Research Corporation.

Details are claimed of a process for producing a mixture of branched chain olefins boiling above 325° F. by polymerizing propylene with an acid polymerization catalyst, e.g., H_3PO_4.

U.S.P. 2,500,672. Synthetic Lubricants. W. E. Garwood, J. W. Brooks, and A. N. Sachanen to Socony-Vacuum Oil Company, Inc.

One mol proportion of a normal alpha mono-olefin with 5-18 C atoms is condensed at a temperature of 500-800° F. with 0.01-1 mol proportion of a conjugated olefin and 0.001-1 mol proportion of a thiol. A viscous oil is obtained.

U.S.P. 2,500,737. Catalytic Conversion of Hydrocarbons. E. A. Coons to Sinclair Refining Company.

In a process for the conversion of hydrocarbons in the presence of finely divided catalyst suspended in vaporized charge oil which involves maintaining a body of high density fluidized catalyst and a superimposed disperse phase thereof, spent catalyst is stripped of oil, regenerated and suspended in vaporized charge oil. This suspension is vigorously agitated before being passed to the reaction zone.

U.S.P. 2,500,755. Polymerization of Cycle Oil from High Temperature Steam Cracking Process. M. C. K. Jones to Standard Oil Development Company.

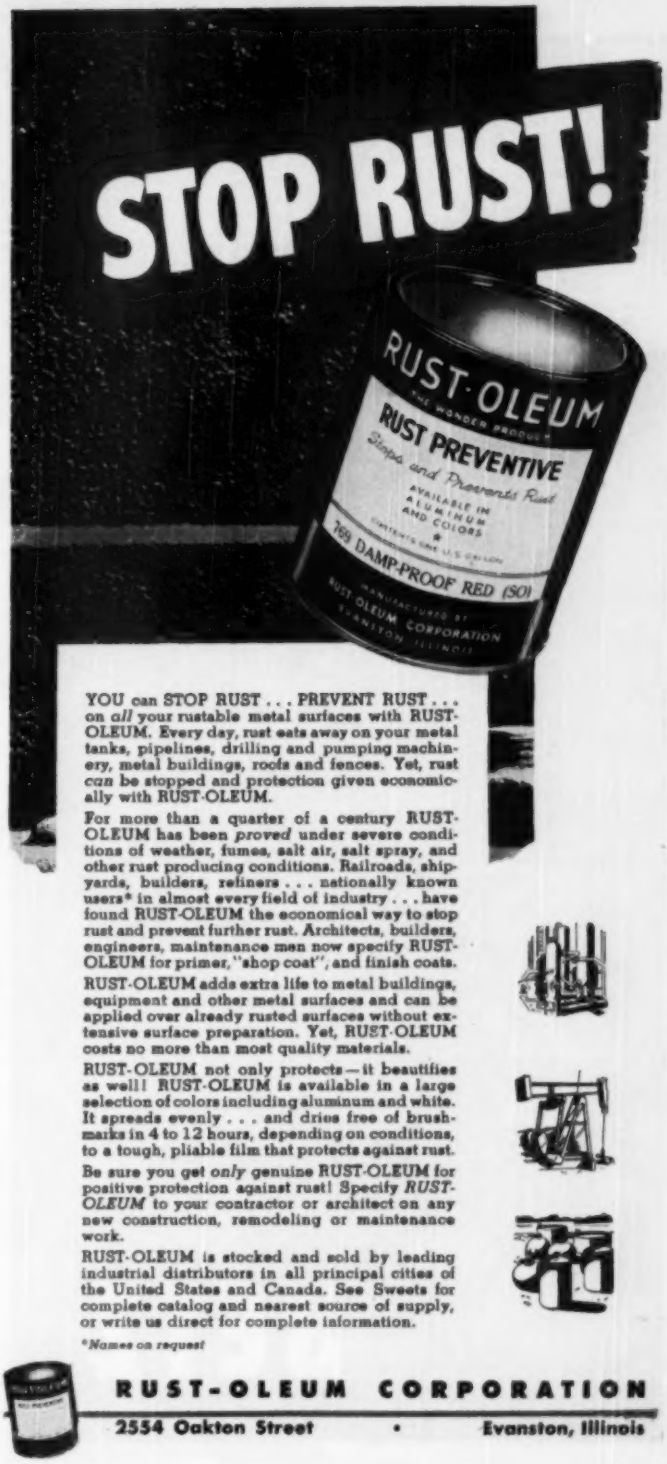
A high-temperature steam cracked cycle oil boiling in the range of 350-700° F. is contacted in liquid phase with an active polymerizing adsorbent, e.g., catalytic adsorptive clay, at a space velocity of .5-2 volumes of oil per volume of the adsorbent per hour while the adsorbent is at a temperature of 350-450° F. More valuable products are formed.

U.S.P. 2,500,780. Stabilization of Low Unsaturation Iso-Olefinic Copolymers. C. F. Van Gilder to Standard Oil Development Company.

A major proportion of isobutylene and a minor proportion of a multiolefin with 4-10 C atoms are copolymerized at a temperature of 0° to —164° C. in the presence of 0.1-5 percent of a 2, 4, 6-trialkylated phenol and a Friedel-Crafts catalyst dissolved in a non-complex-forming solvent liquid at the reaction temperature.

U.S.P. 2,500,983. Emulsion Polymerization Process and Product. P. K. Frolich, B. M. Vanderbildt, and M. W. Swaney to Standard Oil Development Company.

A conjugated diolefin with 4-6 C atoms is heated in aqueous emulsion at a temperature of 25-70° C. for not more than 21 hours in the presence of 3-12 percent of a C_6 to C_{20} tertiary aliphatic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mercaptan until a liquid, oily polymer with an intrinsic viscosity of 0.05-0.4 is formed.

U.S.P. 2,501,023. Hydrocarbon Conversion with Hydrogen Fluoride in Homogeneous Phase. P. L. Brandt, R. J. Lee, and J. A. Ridgway Jr. to Pan American Refining Corporation.

An unsaturated hydrocarbon stock soluble in HF is contacted with HF under such conditions of temperature and pressure that the stock is completely miscible with the HF catalyst. A conversion temperature of 300-500° F. and a pressure sufficient to maintain the reactants in homogeneous liquid phase are employed to obtain substantial cracking.

U.S.P. 2,501,223. Treatment of Synthetic Gasoline. P. H. Johnson to Phillips Petroleum Company.

A raw Fischer-Tropsch type gasoline is passed at a temperature of 700-950° F. through a first contact zone in the absence of steam in contact with a cracking catalyst effective for removing oxygenated materials and isomerizing hydrocarbons. Effluents are passed with steam through a second zone at a temperature of 600-950° F. in contact with a cracking catalyst effective to further isomerize the hydrocarbons. An improved synthetic gasoline is recovered.

U.S.P. 2,501,382. Production of Styrene and Halogenated Styrene. H. A. Dutcher to Phillips Petroleum Company.

Details are claimed of a process for continuous chlorination of butadiene dimer and subsequent dehydrogenation of the vinyl dichlorocyclohexene-3 formed to dichlorostyrene.

U.S.P. 2,501,562. Process for Polymerizing Styrene in the Presence of a Polyvinyl Alcohol-Alkyl Aldehyde Reaction Product. L. D. Cook Jr. to International Detrola Corporation.

Styrene is polymerized at a temperature of 90-145° C. in the presence of a certain amount of the reaction product of polyvinyl alcohol and alkyl aldehyde and a liquid plasticizer. A homogeneous material is formed which is a syrupy liquid at room temperature.

U.S.P. 2,501,692. Aqueous Emulsion Polymerization of Ethylenic Unsaturates in the Presence of Diazo-Thio-Ethers. W. B. Reynolds and E. W. Cotten to Phillips Petroleum Company.

An ethylenically unsaturated hydrocarbon material, e.g., an aliphatic conjugated diene, is polymerized in aqueous dispersion in the presence of a diazo-thio-ether of the formula $R\text{-}N{=}N\text{-}S\text{-}R^1$ wherein R is an aromatic radical and R^1 is an aromatic, cycloalkyl, or aliphatic radical.

U.S.P. 2,501,693. Homogeneous Bulk Polymerization of Ethylenic Unsaturates in the Presence of Diazo-Thio-Ethers. W. B. Reynolds and E. W. Cotten to Phillips Petroleum Company.

The process of this patent is closely related to that of U.S.P. 2,501,692. The diazo-thio-ether here employed shall not contain more than 18 C atoms in each of the groups R and R^1. A high molecular weight linear polymer is formed in a homogeneous bulk fluid reaction mixture.

U.S.P. 2,502,444. Production of High Molecular Weight Elastic Hydrocarbon Polymers in the Presence of Lead Tetraethyl. W. E. Faragher to Houdry Process Corporation.

A conjugated diolefin with 4-6 C atoms is copolymerized with styrene or a methyl styrene in the presence of lead tetraethyl under liquid phase conditions. A high molecular weight elastic copolymer is separated from the reaction mixture produced.

U.S.P. 2,502,953. Process and Apparatus for Contacting Solid Particles and Gaseous Fluid. C. E. Jahnig to Standard Oil Development Company.

Finely divided catalyst particles are maintained in a dry dense fluidized turbulent condition in a conversion zone where they are associated with hydrocarbon vapors. A dense fluidized mixture of spent catalyst particles containing entrained vapors is withdrawn and stripped with upflowing gas in a plurality of stages of different density mixtures to remove entrained gaseous fluid, the dense mixture being at least partially de-aerated to form a more dense fluidized mixture than is maintained in the less dense stages. The velocity of the stripping gas in each stage is selected to maintain a dense fluidized mixture superimposed by a dilute phase.

U.S.P. 2,503,013. Apparatus for Pyrolytic Conversion of Hydrocarbons. K. M. Watson to Sinclair Refining Company.

Details are claimed of an apparatus for

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the conversion of hydrocarbons with the use of a solid catalyst which is caused to gravitate as a continuous, vertically elongated bed downwardly through a vertical chamber having at least one narrow horizontal dimension. The catalyst is passed from the bottom of the column into a stream of hydrocarbon vapors to be processed and carried in suspension upwardly into an enlarged chamber positioned higher than the upper end of the vertical chamber.

U.S.P. 2,503,291. Process of Promoting Reactions in a Fluidized Bed Comprising a Plurality of Catalysts. W. W. Odell.

In a process of promoting chemical reactions in a fluidized mass of catalytic solid particles, e.g., in the oxydation polymerization or cracking of hydrocarbons, or in a Fischer-Tropsch synthesis, a fluid stream of reactant is passed upwardly through a plurality of layers of different catalysts which layers are each a part of the fluidized mass. The different catalysts are so selected and graded that they remain substantially as separate stratified layers in the fluidized mass. The temperature favorable for the reaction is maintained by introducing a temperature controlling fluid into the fluid stream in the fluidized mass at a level between the top and the bottom of this mass.

U.S.P. 2,503,972. Production of Polycyclopentadiene Compositions. J. K. Simons to Libbey-Owens-Ford Glass Company.

Cyclopentadiene is polymerized at a temperature below 0° C. in the presence of a complex of BF_3 and an ether. A rubbery material is formed which can be milled on rolls.

DESULFURIZATION

U.S.P. 2,501,064. Separation of Aromatic and Sulfur Compounds. A. P. Lien and B. L. Evering to Standard Oil Company (Indiana).

A solution of aromatic hydrocarbons and sulfur compounds in liquid HF-BF_3, as obtained for example in extraction operations, is subjected to a dissociative distillation operation at a temperature of 100-200° F. for the dissociation of co-ordination compounds of BF_3 and HF with aromatic hydrocarbons and organic sulfur compounds present. A HF-BF_3 distillate is separated. The residue comprising free aromatic hydrocarbons and HF-BF_3 co-ordination organic sulfur compounds is subjected to gravity separation to separate these two components. The remaining co-ordination compounds can be subjected to dissociative distillation.

U.S.P. 2,503,486. Method of Desulfurization by Treatment with Elemental Halogens. C. M. Himel to Phillips Petroleum Company.

Normally liquid saturated hydrocarbons containing disulfides are desulfurized by contacting them with elemental chlorine, bromine, or iodine at a temperature of 20-250° F. and below that at which halogenation of the hydrocarbon is effected. The disulfides are converted to the corresponding alkyl sulfenyl halides which can be easily removed, e.g.,

by washing with an aqueous alkaline solution. Mercaptan can also be removed from hydrocarbons by this method after oxidation to disulfides, e.g., by contact with $CuCl_2$.

U.S.P. 2,503,528. Removal of Hydrogen Sulfide from Gases. R. Walker, C. R. Wilkins, H. G. Cooper, and J. T. Brown (England).

Gases, such as coal gas, water gas, oil gas, synthesis gas, and the like, are freed from H_2S by a process claimed in detail and including passage of the gases through at least three washing zones where the gases are washed with a single aqueous carbonated alkaline suspension of an iron compound.

U.S.P. 2,503,627. Removal of Mercaptans from Gasoline. J. A. McBride and S. C. Carney to Phillips Petroleum Company.

Mercaptan containing gasoline type hydrocarbons are reacted with a CuCl solution to form cuprous mercaptides. These mercaptides are dissolved in a glycol ether solution which is then separated from the gasoline. The hydrocarbons may also be treated with an aqueous glycol ether-cuprous chloride reagent.

U.S.P. 2,504,058. Process of Removing Sulfur from Oils. H. M. Unschuld, Chicago, and J. G. Alther.

Hydrocarbon oil is desulfurized by subjecting it at a temperature of 190-240° F. to the action of a catalyst consisting of alloys of Ni and Ag, and Zn and Pb, respectively. A short electrical bombardment of the heated oil in the presence of steam by an electric current of special characteristics can be employed for the same purpose.

HYDROGENATION, DEHYDROGENATION, AROMATIZATION

U.S.P. 2,500,482. Catalytic Dehydrogenation. C. Barter to Shell Development Company.

In the dehydrogenation of a saturated hydrocarbon with a chromium oxide catalyst in the absence of added hydrogen, with regeneration of the catalyst, the regenerated catalyst is saturated with dry CO prior to re-use. This saturation is effected without preheating the regenerated catalyst to a temperature higher than the conversion temperature by carrying out this treatment at the dehydrogenation temperature.

U.S.P. 2,500,516. Hydrocarbon Synthesis. M. T. Carpenter to Standard Oil Company (Indiana).

In the exothermic reaction of gases, such as a CO/H_2 mixture, in the presence of a turbulent suspended dense phase catalyst, a multiplicity of separately confined vertically extended catalyst masses of small cross-sectional area is provided. Each of these masses is supported above a gas pervious catalyst barrier close to heat exchange surfaces. Further details of the method are claimed.

U.S.P. 2,500,519. Process and Apparatus for the Synthesis of Hydrocarbons. A.

Kemp Dynamic Dryers solve moisture control problems—combine dependable operation with low operating cost!

YES, no two ways about it, Kemp Dynamic Dryers *control moisture* at rock bottom prices. For example, a Kemp unit drying gas may cost you as little as ¼ *cent per mcf!* And that ¼ of a cent includes *all* labor and utility costs—plus the cost of the equipment amortized over a five-year period! But low operation cost is just part of the Kemp story.

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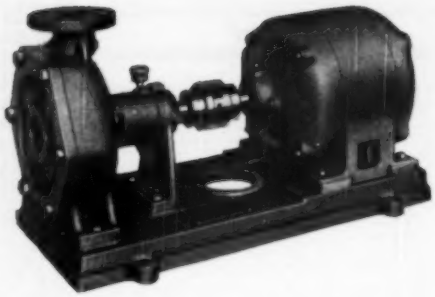

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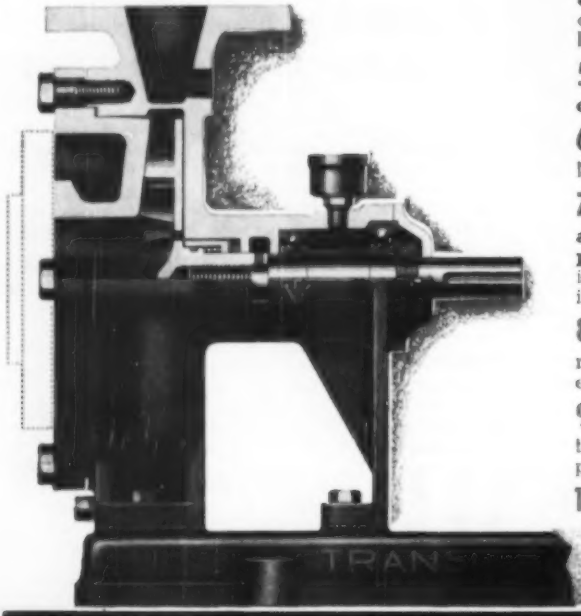

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Patents

Clark to Phillips Petroleum Company.

Details are claimed of a process for a Fischer-Tropsch synthesis in the presence of a catalyst fluidized by the reacting gases. Undesirably high temperatures are prevented near the inlet of the reactor which is of particular construction.

U.S.P. 2,500,533. Preparation of Solid Hydrocarbons. A. H. Friedman to Phillips Petroleum Company.

A mixture containing CO and H_2 in a mol ratio of 1:2 and about 50 percent N by volume is reacted in the presence of a cobalt synthesis catalyst at a temperature of 175-225° C. and a pressure of 5-15 atmospheres, at a space velocity of 100-200 volumes gas per volume catalyst per hour. A high yield of wax is recovered from the reaction effluent.

U.S.P. 2,500,920. Process and Catalyst for Dehydrogenation of Hydrocarbons. A. B. C. Dagne and J. W. Myers to Phillips Petroleum Company.

Aliphatic paraffins with 4-5 C atoms are diluted with 1-20 volumes of steam per volume of paraffin and contacted at a temperature of 1000-1400° F. with a catalyst consisting of a major proportion of Al_2O_3 and a minor proportion of at least one of the oxides of Mo, W, or V.

U.S.P. 2,501,695. Method of Catalytically Synthesizing Hydrocarbons. E. E. Sensel and R. A. Beck to The Texas Company.

A stream of a CO/H_2 mixture is flowing upwardly through a reaction zone in contact with a dispersed fluid phase particle-form synthesis catalyst occupying a substantially greater volume than the settled volume of such particles. The contact is effected in a manner claimed in detail at a low reactant flow velocity without appreciable entrainment of catalyst in the effluent product stream.

U.S.P. 2,502,569. Manufacture of Alkylcyclopentane Hydrocarbons. V. N. Ipatieff and H. Pines to Universal Oil Products Company.

A bicycloalkane hydrocarbon having only one ring of 5 C atoms and one ring of 6 C atoms with 4 C atoms common to the two rings is subjected to destructive hydrogenation at a pressure of 50-150 atm., preferably in the presence of a dehydrogenation catalyst. Alkylcyclopentane hydrocarbons are obtained.

U.S.P. 2,502,958. Simultaneous Hydrogenation and Dehydrogenation. F. B. Johnson to Standard Oil Development Company.

Details are claimed of a process for the preparation of petroleum hydrocarbons from gas oil by catalytic cracking. A 400° F. end point gasoline, an intermediate gas oil fraction containing polycyclic aromatics and boiling above the gasoline, and a bottoms oil containing catalyst particles are segregated from the reaction products and further treated with hydrogenation of the gas oil fraction and hydroforming of a virgin naphtha added to this gas oil.

U.S.P. 2,503,356. Method of Synthesizing Hydrocarbons and the Like. E. E. Sensel, A. J. Millendorf, and R. A. Beck to The Texas Company.

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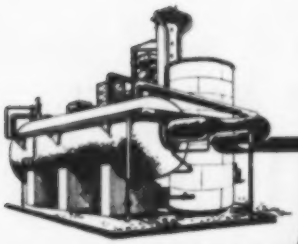

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a temperature of about 390° F. into contact with a cobalt catalyst associated with a minor amount of thoria and essentially free from alkali metal compounds. Effluent from the catalyst comprising unreacted CO and H_2 is passed at a temperature of about 430° F. into contact with additional metallic cobalt catalyst associated with a minor amount of thoria and containing about 5.5 percent sodium carbonate by weight based on the weight of the metallic cobalt.

U.S.P. 2,503,724. Synthesis of Hydrocarbons. J. H. Grahame to Texaco Development Corporation.

Details are claimed of a process for the production of hydrocarbons of high detonation characteristics from a CO/H_2 synthesis gas. The gaseous mixture is passed in individual streams through separate first and second reaction zones. The first zone is maintained at a temperature of 750-900° F. and a pressure of 50-500 atm. and contains a metal oxide isoparaffin synthesis catalyst, while the second zone is maintained at 550-700° F. and a substantially lower pressure and contains an iron type synthesis catalyst. The effluent product stream from the first zone comprises predominantly isoparaffins and CO_2. The CO_2 and residual H_2 are fed into the synthesis gas feed to the second zone. Isoparaffins from the first zone are then reacted with the olefins formed in the second zone to produce liquid alkylate.

HEAVY OILS AND WAXES

U.S.P. 2,500,498. Lubricant. O. M. Reiff and H. J. Andress to Socony-Vacuum Oil Company, Inc.

A viscous mineral oil fraction is compounded with 0.4-1 percent of an alkyl phenyl phosphite and 0.2-1 percent of a lower alkyl-substituted thiophene.

U.S.P. 2,500,762. Lubricant Composition. E. Lieber to Standard Oil Development Company.

A lubricant consists of a major proportion of a waxy mineral lubricating oil and a pour depressing small amount of a polymeric condensation product of specific proportions of an aromatic compound containing more than 2 aliphatic C atoms and a phosphorous halide in the presence of a Friedel-Crafts catalyst.

U.S.P. 2,501,731-2. Modified Lubricating Oil. R. W. Mertes to Union Oil Company of California.

A mineral lubricating oil contains 0.2-3 percent of a complex formed by heating an oil-soluble metal petroleum sulfonate with a metal oxide, hydroxide, carbonate, or bicarbonate together with mineral oil to a temperature of 350-450° F. The detergent capacity of the sulfonate is enhanced by the basic inorganic compound. According to U.S.P. 2,501,732, lead compounds are employed for the sulfonate as well as for the basic inorganic compound.

U.S.P. 2,501,991. Phenate Compounded Oils. J. O. Clayton and W. H. Alderson to California Research Corporation.

A mineral lubricating oil contains about 0.1-2.5 percent by weight on finished oil of an alkaline earth metal salt

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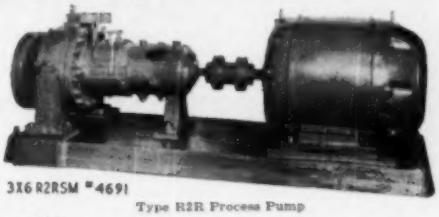
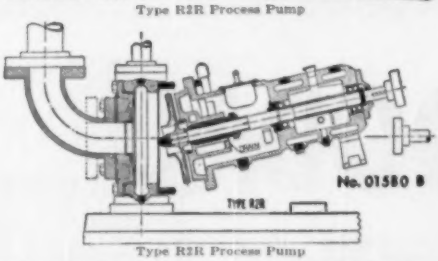


Type R2R Process Pump



Type R2R Process Pump

DISASSEMBLY: The Type R2R process pumps can be disassembled without disconnecting the suction and discharge piping. By first removing the spacer from the spacer type coupling, and unbolting the casing from the cradle the entire cradle and complete rotating element can be removed without disturbing the suction and discharge piping.

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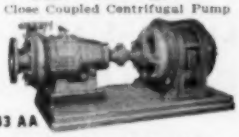

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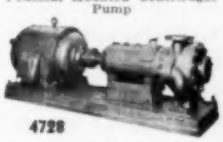

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Durable Duplex Packed Piston Pattern Steam Pump. Side Pot Type

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Patents

of a m- or p-phenol containing attached to the aromatic nucleus the group O-R wherein R is an aliphatic group with 5-30 C atoms, such as a substituted resorcinol salt. The additive has detergent properties.

U.S.P. 2,501,992. Lubricating Oils. J. O. Clayton and W. H. Alderson to California Research Corporation.

The product of this patent is closely related to that of U.S.P. 2,501,991. It contains still a second additive, viz. a selenium compound of the formula $R^1\text{-}(Se)_m\text{-}R^2$ wherein R^1 and R^2 are hydrocarbon radicals of at least 7 C atoms and attached to Se by a non-benzenoid C atom, and m is 1 or 2.

U.S.P. 2,502,408. Lubricating Composition. D. E. Adelson to Shell Development Company.

A lubricating mineral oil is compounded with 0.1-5 percent of a reaction product obtained by treating at a temperature of 170-350° F. a phosphorous oxide with a high molecular weight unsaturated cyclic ketone fraction containing at least 12 C atoms and further treating the product thus obtained with sulfur at a temperature of 240-450° F.

U.S.P. 2,503,290. Lubricant Composition. H. D. Norris and J. H. McCracken to Socony-Vacuum Oil Company, Inc.

A major proportion of an oil of lubricating viscosity is compounded with a minor proportion of 2,2,3,4,5,5-hexachlorothiolane (e.g., 0.1-20 percent by weight) to improve the extreme pressure characteristics of the oil.

U.S.P. 2,503,401. Lubricants. L. A. Mattano and L. W. Mixon to Standard Oil Company of Indiana.

A hydrocarbon oil contains 0.001-2 percent of a 1,3,4-tricarboxy-2-thiabutane having the general formula $H_2C(CO_2R)\text{-}CH(CO_2R')\text{-}S\text{-}CH_2(CO_2R'')$ wherein R,R', and R" are either hydrogen or alkyl radicals. At least one of the R's shall be hydrogen and at least one shall be an alkyl radical with at least 10 C atoms. The additive imparts corrosion and/or rust preventive properties to the composition.

U.S.P. 2,503,969. High-Temperature Lubricating Grease. H. W. Rudel and A. J. Morway to Standard Oil Development Company.

A lubricating grease essentially consists of mineral base lubricating oil and of 20-40 percent by weight of the sodium soap of rapeseed oil. The composition shall have a substantial glycerine content and a content of 0.25-2 percent excess alkali calculated as free NaOH, 0.1-2 percent phenyl alpha naphthylamine, and 0.1-1 percent of dibenzoyl acetone ethylene or propylene diamine. This high temperature lubricating grease is stabilized against oxidation.

U.S.P. 2,504,085. Mineral Oil Composition Containing Hexachlorothiolene. H. D. Norris and J. H. McCracken to Socony-Vacuum Oil Company, Inc.

A major proportion of mineral oil is compounded with a minor proportion of 2,2,3,4,5,5-hexachloro-3-thiolene. The additive improves the extreme pressure characteristics of the oil. (See U.S.P. 2,503,290).

PETROCHEMICALS

U.S.P. 2,500,599. Catalytic Hydroxylation of Olefinic Compounds. I. Bergsteinsson, T. W. Evans, and J. R. Scheibli to Shell Development Company.

A mono-olefinic hydrocarbon is reacted with hydrogen peroxide in the presence of formic acid. A dihydric alcohol is produced.

U.S.P. 2,500,913. Oxo-Synthesis Followed by Hydrogenation to Alcohols. R. E. Schexnaidler Jr. to Standard Oil Development Company.

Olefins and equimolecular amounts of CO and H_2 are contacted in a liquid phase with a catalyst consisting of silica hydrogel impregnated with cobalt, thoria and copper under pressures of 100-300 atm. and at temperatures of 200-400° F. The resulting oxygenated organic compounds, comprising aldehydes with one C atom more than the olefins employed, are hydrogenated under corresponding pressures to form alcohols.

U.S.P. 2,501,088. Catalytic Oxidation of Aromatic Hydrocarbons in Presence of Nitroalkanes. H. Pines and B. Kvetinskas to Universal Oil Products Company.

An aromatic hydrocarbon of at least 7 C atoms is reacted with an oxygen-containing gas in the presence of a nitroalkane. Aromatic alcohols and carbonyl compounds are produced.

U.S.P. 2,501,200. Process for Production of Menthane Aldehyde. R. B. Wearn to Food Machinery & Chemical Cor-

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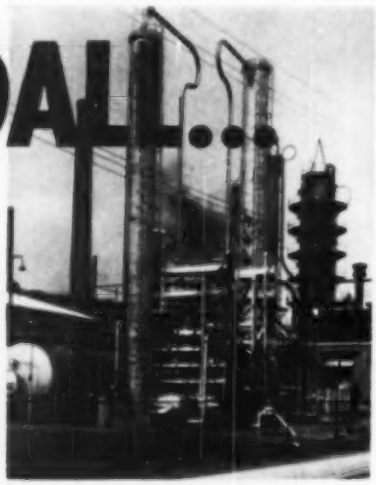

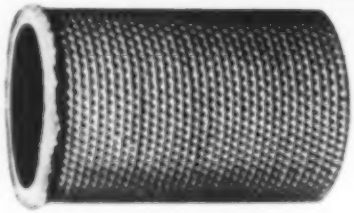

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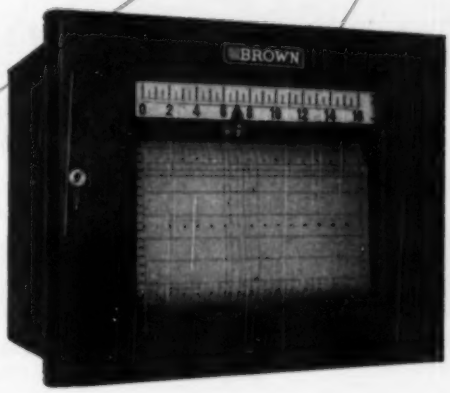

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poration.

Dipentene or limonene is reacted with hydrogen at elevated temperature and pressure in the presence of a hydrogenation catalyst. After saturation of the side chain double bond, CO is introduced under corresponding conditions until an aldehyde group is substituted on the 2-position of the reactant.

U.S.P. 2,501,509. Preparation of Amines. W. F. Gresham, R. E. Brooks, and W. M. Bruner to E. I. du Pont de Nemours & Company.

An olefin, e.g., butadiene, is heated with ammonia or a primary or secondary amine in the presence of an alkali metal catalyst and 0.5-10 parts of an organic liquid diluent for the olefin at a temperature of 50-350° C. and a pressure of 1-1500 atms. Amines are produced, such as N-mono-, or di-, or tributenylhexamethylenediamine.

U.S.P. 2,501,556. Alkali Metals and their Hydrides as Catalysts in Amine Condensation. G. M. Whitman to E. I. du Pont de Nemours & Company.

The process of this patent is closely related to that of U.S.P. 2,501,509. An acyclic hydrocarbon with not more than 6 C atoms and a double bond between the C atoms in the 1,2-positions as the sole unsaturation is heated here with the basic ammonia-type compounds under anhydrous conditions at a temperature of at least 100° C. and a pressure of at least 225 atoms in the presence of an alkali metal or alkali metal hydride catalyst.

U.S.P. 2,501,600. Resinification of Aromatic Hydrocarbons. C. F. Feasley to Socony-Vacuum Oil Company, Inc.

An aromatic hydrocarbon stock is condensed at elevated temperature with formaldehyde in the presence of an acid activated clay of the montmorillonite type, freshly calcined Attapulgus clay, or an alumina-silica gel catalyst with 7-15 percent alumina and silica gel as the sole essential condensing agent. Viscous liquids and/or resinous solids are obtained.

U.S.P. 2,501,792. Synthesis of Disulfides. F. M. Smith to Phillips Petroleum Company.

Novel aralkyl disulfides, such as bis (xylyl alkyl) disulfides, useful as additives to prevent the deterioration of lubricating oils, can, for example, be obtained from a xylene concentrate prepared from a highly aromatic naphtha by removing olefins therefrom by polymerization. A mixture of this concentrate with a conjugated diolefin is contacted with an alkenylation catalyst to produce an alkenyl xylene which is then treated with H_2S in the presence of a suitable catalyst and thereafter oxidized to form disulfides.

U.S.P. 2,502,596. Reaction of Hydrogen Sulfide with Olefins. W. A. Schulze to Phillips Petroleum Company.

In a process for reacting heavy olefins of more than 4 C atoms with H_2S in the presence of a mercaptan-synthesizing catalyst, the reaction is initiated with fresh catalyst in the presence of sufficient propane diluent to avoid a temperature rise of more than 50° F. The proportion of diluent in the reaction mix-

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ture is reduced as the catalyst activity declines. The temperature is maintained substantially constant within the optimum range. Organic sulfur compounds, particularly high molecular weight mercaptans, are produced.

U.S.P. 2,502,678. Method for Preparing Acrylonitrile by Vapor Phase Catalytic Reaction of Acetylene and Hydrogen Cyanide. D. C. Spaulding and C. E. Brockway to The B. F. Goodrich Company.

Acetylene is reacted with HCN in the vapor phase at a temperature of 500-675° C. and in the presence of an alkali metal oxide catalyst and a barium compound promoter, both supported on non-activated charcoal in amounts of 6-10 percent catalyst and 0.5-4 percent promoter by weight of the support.

U.S.P. 2,503,253. Azo Catalysts in Preparation of Sulfonyl Chlorides. M. L. Ernsberger and P. S. Pinkney to E. I. du Pont de Nemours & Company.

An aliphatic or cycloalphatic hydrocarbon is treated with a mixture of SO_2 and Cl_2 in the presence of an azobis (cyanoalkane) catalyst wherein the cyano group is attached to tertiary carbon which is attached to the azo nitrogen, or of an azobis (cyanocycloalkane) of corresponding constitution. Hydrocarbon sulfonyl chlorides are produced. Alpha, alpha'-azodiisobutyronitrile and alpha, alpha'-azobis (alpha, gamma)-dimethylvaleronitrile are examples of useful catalysts. Irradiation with actinic light is not required for this process.

U.S.P. 2,503,279. Azo Catalysts in Preparation of Sulfonyl Chlorides. W. H. Lockwood to E. I. du Pont de Nemours & Company.

The process of this patent is very closely related to that according to U.S.P. 2,503,253, the only essential difference being the use of sulfonyl chloride instead of the mixture of SO_2 and Cl_2.

U.S.P. 2,503,280. Azo Catalysts in Preparation of Sulfonic Acids. W. H. Lockwood to E. I. du Pont de Nemours & Company.

The process according to this patent is closely related to that of U.S.P. 2,503,-253. In the present case, the saturated hydrocarbons are treated with SO_2 and oxygen in the presence of the new type of catalyst to form a sulfonic acid.

U.S.P. 2,504,034. Production of Maleic Acid from Branched-Chain Dienes. C. E. Morrell, L. K. Beach, and M. E. Cunningham to Standard Oil Development Company.

A gaseous mixture of C_5 diolefins boiling between 65-80° C., and consisting essentially of methyl pentadienes, with air is oxidized in the presence of a vanadium oxide catalyst at a temperature of 500-600° C. Maleic acid is formed.

U.S.P. 2,504,068. Production of Octachlorothiolane. H. L. Coonradt and H. D. Hartough to Socony-Vacuum Oil Company, Inc.

Liquid thiophene is contacted with excess chlorine in the presence of iodine, iodine monochloride, or iodine trichloride in an amount equivalent to at least 1 gram atom of iodine per mole of thiophene. Octachlorothiolane is produced.

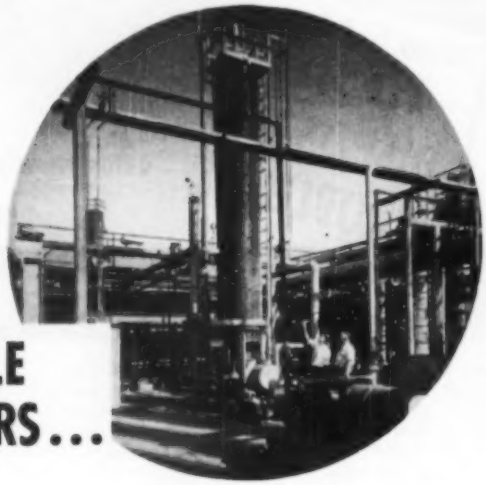
CATALYST PREPARATION, ACTIVATION, AND REGENERATION

U.S.P. 2,500,146. Catalysts for Conversion of Hydrocarbons. R. N. Fleck and P. G. Nahin to Union Oil Company of California.

Hydrocarbons are subjected to temperatures of 500-1200° F. under gauge pressure of —14 to 1500 psi. in the presence of a catalyst comprising 1-15 percent of an oxide of a heavy metal of atomic No. 22-42, and 85-99 percent of bauxite containing oxides of iron, silicon, titanium, and sodium in small amounts. The process is useful in the reforming or conversion, e.g., dehydrogenation or aromatization, of hydrocarbons, and simultaneously causes desulfurization.

U.S.P. 2,500,197. Hydrocarbon Conversion Process and Catalyst Therefor. W. Michael, O. Goehre, G. Free, W. V. Fuener, and W. Schneider to the Attorney General of the U.S.A.

A hydrocarbon conversion catalyst is prepared by precipitating 1 part of sodium silicate containing about 0.28 part of SiO_2 diluted with 9 parts of water with a solution of 0.23 part of NH_4Cl in 1.5 parts of water, adding thereto while stirring a solution of 0.23 part of aluminum nitrate ($9H_2O$) and 1.5 parts of water and concentrated amonia water until the mixture is alkaline. The precipitate is then boiled, filtered, washed and dried at about 200° C. The resulting catalyst is especially useful in splitting carbonaceous materials, e.g., in producing high anti-knock gasoline from a



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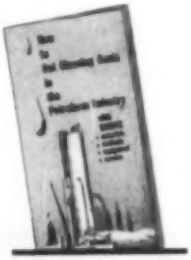

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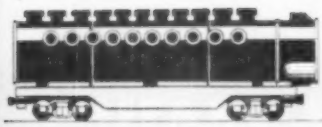

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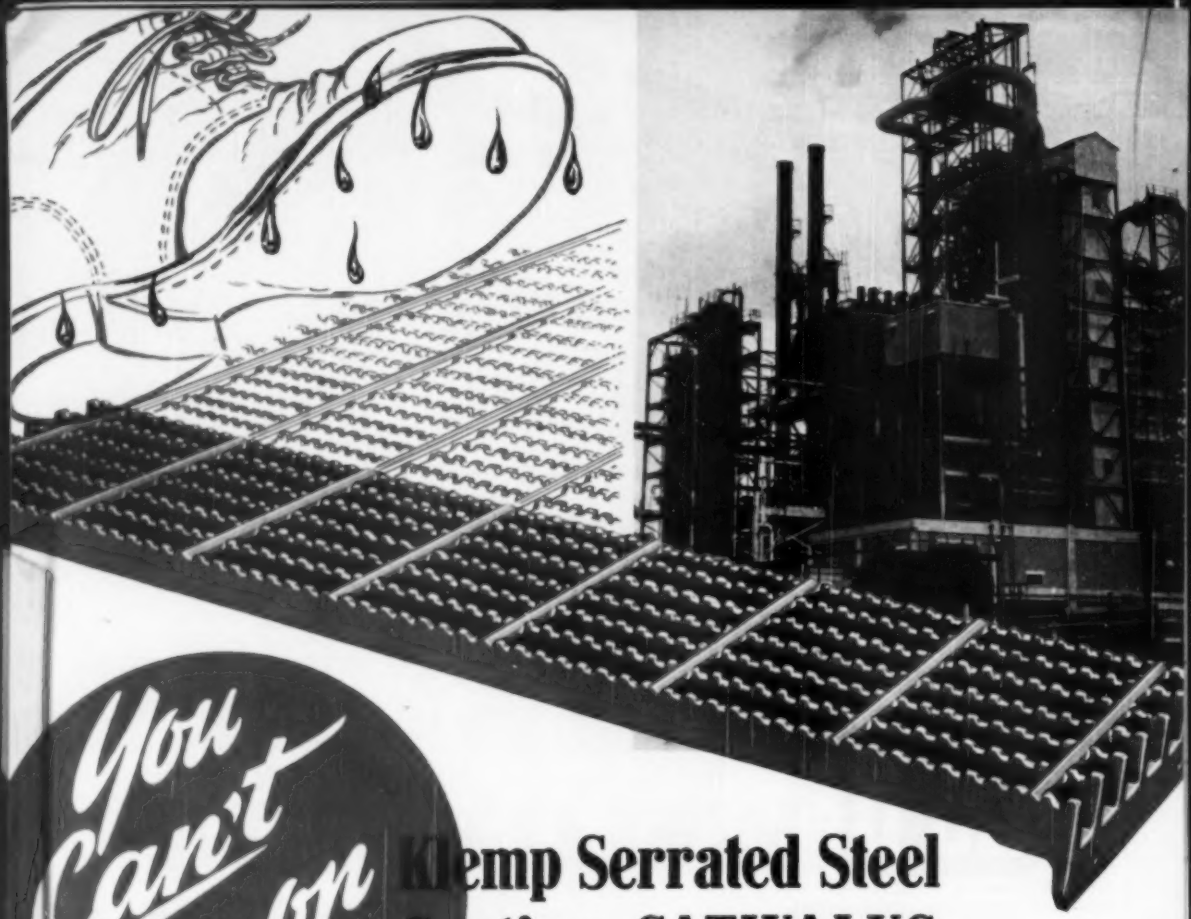

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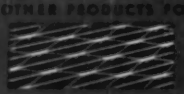

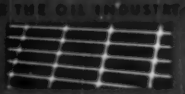

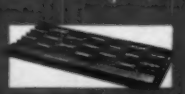

Patents

hydrocarbon charge oil boiling between 200-350° C.

U.S.P. 2,500,210. Preparation of an Oxo Synthesis Catalyst. R. E. Schexnailder Jr. to Standard Oil Development Company.

A catalyst useful in synthesizing oxygenated compounds from olefins, CO and H_2, is prepared by causing a silica hydrosol to set to a hydrogel, impregnating this hydrogel with decomposable salts of Co, Th and Cu, subjecting the mixture to conditions for decomposing these salts, heating the catalyst for activation, and reducing it with hydorgen.

U.S.P. 2,500,331. Process of Applying Promoters to Catalyst Particles. V. Voorhees to Standard Oil Company of Indiana.

Details are claimed for preparing a finely divided fluidizable iron catalyst containing an alkaline or alkaline earth metal promoter in uniform distribution.

U.S.P. 2,500,776. Method of Reactivating Reduced Metal Oxide Catalysts. J. W. Teter to Sinclair Refining Company.

A reduced Co or Ni oxide catalyst from the reaction of olefins with ammonia is reactivated and freed from tarry deposits by passing hydrogen in contact with the catalyst under special conditions of elevated temperature and pressure.

U.S.P. 2,500,801. Preparation of Catalytic Bodies. J. F. Church to Phillips Petroleum Company.

Porous catalytic siliceous pebbles are prepared by dispersing molten glass into a cooling column. The dispersed glass spheres formed are gradually cooled and solidified as they gradually descend through a rising stream of hot gas maintained at a temperature below the melting point of the glass. The resulting glass spheres are separated into two phases by heat treatment at 525-600° C. in the lower portion of the column.

U.S.P. 2,500,938. Art of Diluting Steam or Moisture Formed or Released During Regeneration of Contact Material. J. E. Evans to Houdry Process Corporation.

In the regeneration of contact material a portion of the hydrocarbonaceous deposit is burnt by regenerating gases in an area at the entrance of the regenerating zone with resultant production of a mixture of steam and flue gases with the steam tending to be in substantial concentration. A quantity of largely steam-free diluting gases is admixed to this mixture after the beginning of the regenerating burning process whereby the concentration of steam in the mixture is reduced and loss of catalytic activity of the regenerated contact material is inhibited.

U.S.P. 2,501,197. Catalytic Treatment of Hydrocarbon Oils. P. L. Veltman and A. R. Goldsby to The Texas Company.

A solid hydrocarbon conversion catalyst comprises a metallic fluoride compound nonvolatile at temperatures below 1200° F. and preferably containing MgF_2, AlF_3 and silica.

U.S.P. 2,501,436. Process for Effecting Catalytic Conversion with Finely Divided Catalysts. D. L. Cleveland, J. A. Hatton, and G. C. Montgomery to Shell Development Company.

Details are claimed of a process in which a higher equilibrium activity of a conversion catalyst may be maintained at any given catalyst replacement rate. For this purpose a portion of the catalyst in the system is subjected to a grinding treatment before it is recycled.

U.S.P. 2,502,348. Catalysts. I. Scriabine, J. F. Billan, A. F. S. Bellone, and M. Gillard to Soc. des Usines Chemiques Rhone-Poulenc.

A finely divided porous nickel hydrogenation catalyst consists essentially of a Ni-Cr alloy in porous, activated form, wherein Cr is present in a proportion of 0.5-3.5 percent of the Ni content.

U.S.P. 2,502,930. Preparation of Catalyst. R. L. Daussat and O. W. Moak to Standard Oil Development Company.

A heat stable catalyst of high mechanical strength is prepared by impregnating aluminum trihydrate of low sodium content with a soluble molybdenum compound. The impregnated mass is heated to decompose the molybdenum compound and to activate the composition. A plastic clay is then admixed with the composition which is thereafter heated again.

U.S.P. 2,502,954. Apparatus for Contacting Solids and Gaseous Fluids. F. H. Blauding to Standard Oil Development Company.

Details of an apparatus are claimed for contacting solid particles and gaseous fluids, particularly for stripping spent catalyst before its regeneration to remove volatile hydrocarbons.

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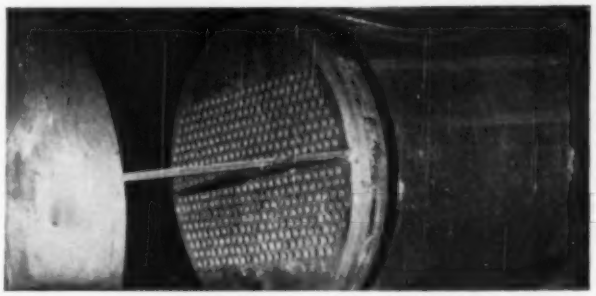

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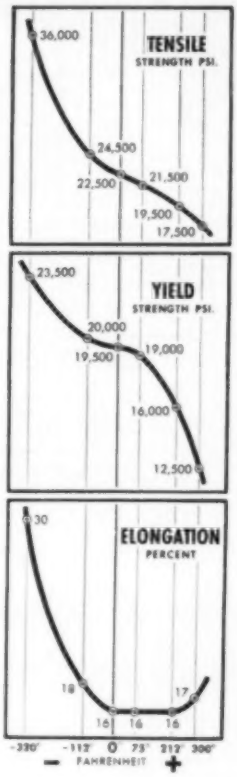

These three graphs show the amazing increase in tensile properties of aluminum as temperatures drop below zero.

Patents

U.S.P. 2,503,913. Process of Drying Inorganic Hydrogel Particles. C. N. Kimberlin, Jr. and J. A. Pierce to Standard Oil Development Company.

Inorganic hydrogel particles to be used for catalytic purposes, or the like, are dried by mixing them with N-butanol containing 0.5 percent of sorbitan monooleate and then distilling the water as an azeotrope with the butanol until the water is removed from the hydrogel. The butanol is thereafter removed from the dehydrated hydrogel.

U.S.P. 2,503,963. Method for Preparing a Fischer-Tropsch Catalyst. M. A. Mosesman to Standard Oil Development Company.

A mixture of 2 parts of finely divided iron and 3 parts of alkali metal nitrate is ignited. The reaction product formed is treated with free oxygen at a temperature of about 1000° F. for about 4 hours. The oxidized mixture is treated in a reducing atmosphere at about 700° F. for about 24 hours. A Fischer-Tropsch synthesis catalyst is formed which may be used for long periods in the synthesis of high yields of hydrocarbon products.

U.S.P. 2,503,964. Preparation of an Iron-Alkali Metal Ferrate Catalyst. M. A. Mosesman to Standard Oil Development Company.

The process of this patent is closely related to that according to U.S.P. 2,503,963. The ignited mixture of iron and alkali metal nitrate is added to iron oxide in an amount of 0.2-20 percent by weight of the iron oxide mixture. The mixture thus obtained is further treated in an oxidating and a reducing atmosphere under the conditions described in said patent.

U.S.P. 2,504,001. Preparation of Silica-Vanadia Catalyst. G. C. Connolly to Standard Oil Development Company.

Details are claimed of a method of preparing a catalyst comprising silica and vanadium oxide from a sodium silicate solution transformed to a silica hydrogel by acid treatment. The washed hydrogel is then mulled in the presence of an ammonium vanadate solution, and the resulting mixture is subjected to further treatment.

List of US Patents

"Telling the Age of a United States Patent" lists the number of each, reissue, design, and trademark granted at the beginning of each calendar year from 1836 to date. The pocket-size folder, published by Invention, Inc., which has furnished Patent Reporting Services to manufacturers and their patent attorneys since 1937, reveals that as of March 7, the 2.5 billionth patent had been granted by the U. S. Patent Office.

For a copy write Patent Reporting Division, Invention, Inc., Munsey Building, Washington 4, D. C.

Phillips Research Planners Announce Assignments

A Research Planning Board established by Phillips Petroleum Company as part of the Research and Development Department (See page 154, May PR) announces assignments in the research division as follows: W. B. Reynolds, assistant director in charge of chemicals and rubber branch; F. W. Crawford, assistant director in charge of production and physics branch; and D. E. Carr, assistant director in charge of combustion and lubrications branch.

In charge of hydrocarbon conversion branch is F. E. Frey. R. W. Blue has been transferred from the production and physics branch to hydrocarbon conversion branch, in charge of fundamental catalysis section. The former fuels and lubricants division has been separated into the hydrocarbon conversion branch and the combustion and lubrication branch.

In the patent division, J. A. Young replaces Hudson as manager with J. P. Jones, as assistant maanger. D. J. Quigg has been made one of the four legal branch section chiefs, and George Benz is to remain manager of the chemical engineering division. C. K. Buell is assistant manager.

An administration and personnel branch, established in the research and development department, serves four departamental divisions. L. C. Morris has been appointed office manager in charge of the new branch, with R. R. Couch as assistant office manager.

Chicago Fair Features Petroleum Service Center

"Petroleum Service Center," is the oil industry's contribution to the Chicago Fair of 1950 to be held June 24 through Labor Day in Chicago where some nine oil companies will participate in answering questions about the fair, Chicago, travel, time reports, etc. No petroleum products will be offered for sale in the center. Also provided will be sound films relating to the story of petroleum and the industry's general development over the last 91 years. Dramatic murals will graphically depict the story of how the more than 2000 petroleum products serve the public.

Chemicals Wanted

The National Registry of Rare Chemicals, Armour Research Foundation, 33rd, Federal and Dearborn Streets, Chicago 16, has received urgent requests for the chemicals listed below. If anyone has one or more, even if only one gram quantities, please inform the Registry.

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1,1-Diiodo-2-methylpropane
2-Iodo-3-methylbutane
Dihydroxymethyl ether
2,5Dinitrophenol
3,5-Dinitrophenol
Heptane-1,3-dithiol
Heptane-2,4-dithiol
Hexane-1,3-dithiol
2-Cyanobutadiene-1,3
1,3-Dibromohexane
1,3-Dibromopentane
2,5-Dichlorocyclohexylamine
Betaine aldehyde
Solochrome cyanine
1,6-Diphenylhexatriene
Rubrene
3-Hexene
3-Hexanethiol

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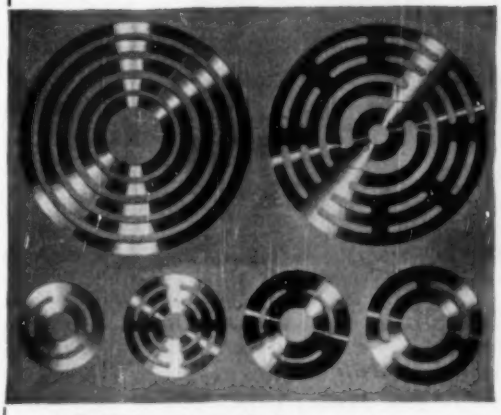

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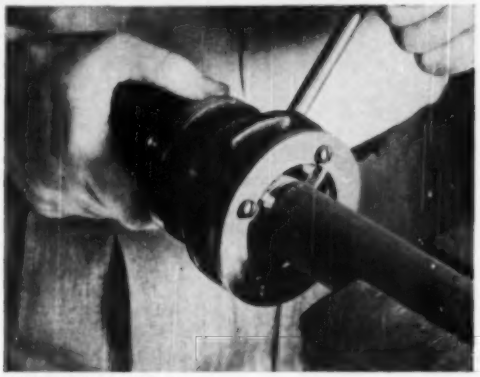
MACHINED—*not punched out*—which prevents cracks and strains thus eliminating breakage risk of fragments of broken plates getting in cylinders. Best obtainable alloy steels used to meet requirements. Oil hardened and tempered to correct hardness. Precision ground to perfect flatness.

Let VOSS make your next Valve Plates and Discs!

J. H. H. VOSS CO., Inc. 785 East 144th Street NEW YORK 54, N. Y.

Get this new HAND threader for "Karbate" Pipe BRAND

TOOL ABOUT TO BE INSERTED IN "KARBATE" PIPE.



TOOL CUTTING THREADS.

TOOL REMOVED. NOTE CLEAN, SHARP THREADS.

WRITE to National Carbon today and ask us for complete information on the new hand-threading tool for use with "Karbate" impervious graphite pipe. The new tool eliminates the need for an expensive lathe and is easy to carry to any job site. It cuts "Karbate" impervious graphite like wood . . . delivers clean, sharp threads . . . is inexpensive to buy. If you like, we'll have a salesman call and demonstrate the tool to you in person, without cost or obligation.

MORE THAN DOUBLE THE USABLE LIGHT! . . .

The biggest news since the invention of flashlights—the brand new "Eveready" No. 1050 flashlight battery—gives more than double the usable brilliant white light for critical uses than any other flashlight battery we have ever made.

NO METAL CAN TO LEAK OR CORRODE!

The terms "Karbate" and "Eveready" are registered trade-marks of

NATIONAL CARBON DIVISION
UNION CARBIDE AND CARBON CORPORATION
30 East 42nd Street, New York 17, N. Y.

District Sales Offices:
Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco

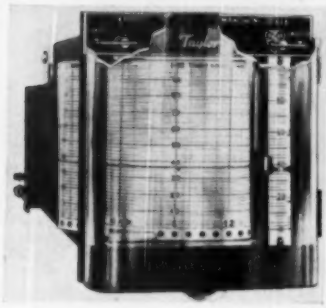
Foreign Department: New York, U. S. A.

These products sold in Canada by National Carbon Limited, Toronto 4

NEW EQUIPMENT and Manufacturers' Literature

For copies of manufacturers' literature or more information about products described on these pages use the coupon below, circling the number shown for each item desired.

Recording Receiver



1 A new recording receiver of Taylor Instrument Companies enables a greater reduction in panel size as it can be fitted into a 3⅞-inch by 4½-inch opening. Controls are locally mounted. The 3-inch, 30-day strip chart travels from right to left 1 inch per hour and can be read above or below eye level. It is designed with vertical time lines and is available in 100-line even graduations or in 0 to 10 square root. The scale at right shows actual process range of the transmitter and is graduated 3 to 15 psi. for noting valve position and checking calibration. Bulletin 98079 gives further information.

Extinguisher

2 A cartridge-operated water type fire extinguisher with stainless steel shell has been developed by Pyrene Manufacturing Company. A plastic nozzle delivers a 40-foot stream when the extinguisher is turned upside down and struck on the floor, releasing gas contained in the cartridge fitted into the extinguisher cap. The carbon dioxide pressure cartridge need be replaced and the water replenished only if the extinguisher is discharged. It is said to have been given a 43 percent higher test for 500 pounds rather than the customary 350 pounds for riveted units.

Exchanger Units

3 Designed for the metal cleaning and finishing industry, Nukem Products Corporation's Karbate unit exchanger utilizes the acid resistance of non-metallic materials. Also introduced as a service by the company is "Nukemizing," a new method of corrosion-proofing, plating, pickling, chemical process and storage tanks. A Nu-Kast No. 166 pump is designed to circulate the acid solution through the exchanger tubes at a high velocity. Literature describing the pump, Nukemizing, and the exchanger units is available.

Turbidity Recorder

4 A photoelectric instrument which automatically measures and records the amount of suspended particles in a liquid has been announced by General Electric Company's special products division. Called a "recording turbidimeter," the instrument monitors and controls processes in water treatment plants or wherever turbidity is a significant condition of the process. Compact in design, it automatically gives continuous readings of turbidity, alerting the operator when certain predetermined limits are exceeded. The instrument scale reads any desired range of turbidity such as 0 to 10 parts per million, 100 to 1000 ppm., 90 to 100 ppm., etc. Operating on a 115-volt, 50/60 cycle circuit, the equipment has a power consumption of approximately 150 watts.

Scarifiers

5 Back rip scarifiers, mounted on the back-side of bulldozer moldboards, which rip the ground when the tractor backs up and float on top of the ground when moving forward, are introduced by Preco Incorporated. They are available for all standard straight blade bulldozers. The teeth rip and loosen packed soil, black top and hard ground, raking out rocks and roots and smoothing the ground for easier and faster forward blading. The teeth are made of steel alloys. A set of back rip scarifiers consists of four curved shanks capped

FOR ADDITIONAL INFORMATION on products and literature mentioned in this section circle item numbers, cut out and mail this coupon. Prompt action is suggested so that data will be readily available.

PETROLEUM REFINER
BOX 2608, HOUSTON 1, TEXAS

Please have manufacturers send me, without obligation, additional information about items from June, 1950, New Equipment Section whose numbers are circled below:

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62								

Name _____ Title _____

Company _____

Street address _____

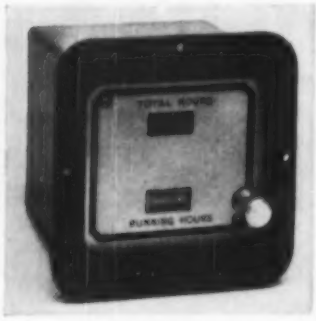
City and State _____

New Equipment

(For additional information or literature check item numbers on mailing coupon, page 191.)

look-on replaceable teeth, each mounted in a separate housing which is welded to the back of the bulldozer moldboard.

Running Hours Meter



6 Phillips Petroleum Company's running hours meter, a totally-enclosed dust-proof, electrical recorder indicates total and current operating hours on separate counters. Meter operates in any position. It consumes 4 watts of 115 volt, 60 cycle power and requires 3½ by 3½ inch panel space. Weight is 18 ounces. Each counter registers to 9999.9 hours in 6-minute increments. Knurled knob resets running hours. High torque, synchronous motor is permanently lubricated. Electrical terminals are on meter back.

Fuel Oil Stabilizer

7 A new inhibitor for retarding the formation of sediment and maintaining color during the storage of distillate fuel oils has been developed by Universal Oil Products Company. Known as No. 176-5, the inhibitor is available for laboratory and plant application, and is said to promote rapid settling of tank bottoms and sediments. It is "effective in blends of virgin and cracked distillates as well as in the individual components in concentrations as low as 0.002-0.02 percent."

Self Pressurizing Fuel

8 A self-pressurizing and self-vaporizing fuel known as "Prepo," introduced by Pressure Products Corporation, is compounded of several hydrocarbons which are blended to provide a pressure that is constant enough to continue until the fuel can is emptied. Shown is the fuel applied to a hand torch which lights instantly, delivering a clean, blue flame of more than 2200°. Prepo cannot be poured from the container. A rubber valve mounted on top of the container permits it to be attached to a mating fixture on other appliances. It is said to be non-toxic and non-poisonous.

Machine Vise

9 Van Products Company's new machine vise with adjustable gibs and a moving jaw is so designed that the usual tendency to rise up from the vise bed is prevented by the long arms which extend forward from the lower side of the jaw. Stroke of the standard model is 1¼-inches. A 6-inch stroke is available for special uses as pressing, shaping, forming, etc. The jaws are 8¾-inches wide and open to a maximum of 11 inches.

Steam Trap

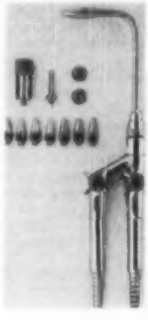
10 A stainless steel bar stock body is used in Yarnall-Waring Company's impulse steam trap instead of the cold-rolled-steel cadmium-plated body previously furnished for working pressures up to 400 pounds and temperatures up to 450° F. Bulletin T-1739.

Heat Insulation

11 A self-set type of 85 percent magnesia for heat insulation has been offered by Philip Carey Manufacturing Company. "Super-Light" magnesia is a mixture of not less than 85 percent basic hydrated carbonate of magnesia and 10 to 15 percent of asbestos fibre. It has a density of from 9½ to 10½ pounds per cubic foot compared to 13 to 17 pounds per cubic foot in the filter molded type. Standardized sizes range from ⅛ to 6 inches copper tubing; iron pipe sizes from ¼ to 18 inches; and in wall thicknesses from nominal 1 inch to nominal 4 inches or thicker.

Hand Torch

12 Removal of a single hex nut permits the interchange of injectors and mixing discs in Hoke, Inc.'s jewel hand torch which can be used for working Pyrex glass and quartz, silver soldering, lead burning, ampoule sealing, etc. Injector need be changed only when oxygen is being replaced by air. Torch is constructed of bar and forged brass and finished in nickel. Designed with "one-hand-finger tip control," its flames are said to be instantly adjustable as to size and intensity.



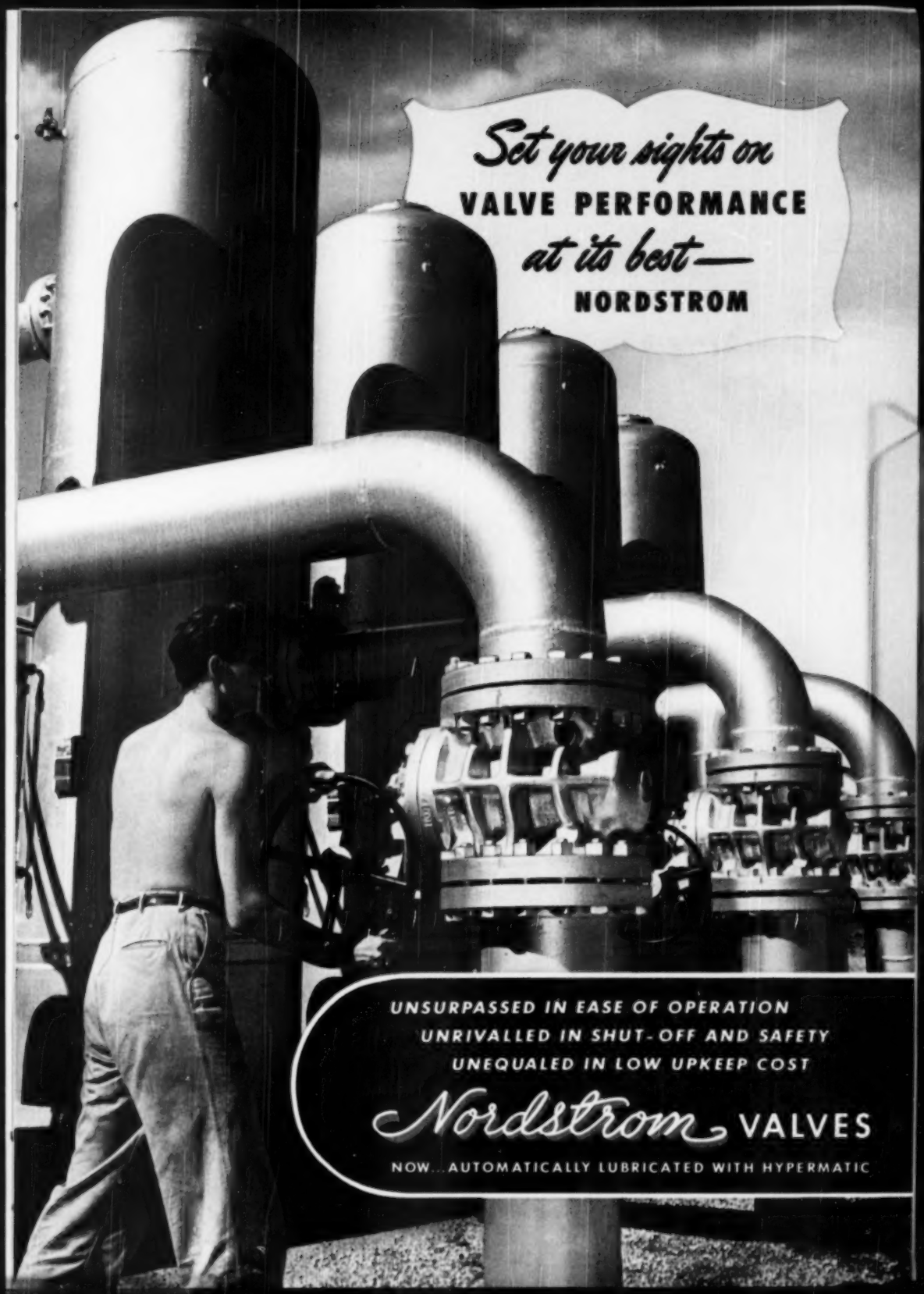
Centrifugal Pump

13 A non-clogging centrifugal pump of Bingham Pump Company for use in pumping high-pressure oil products as residuum, flash tower bottom, and black oil recycle, comprises

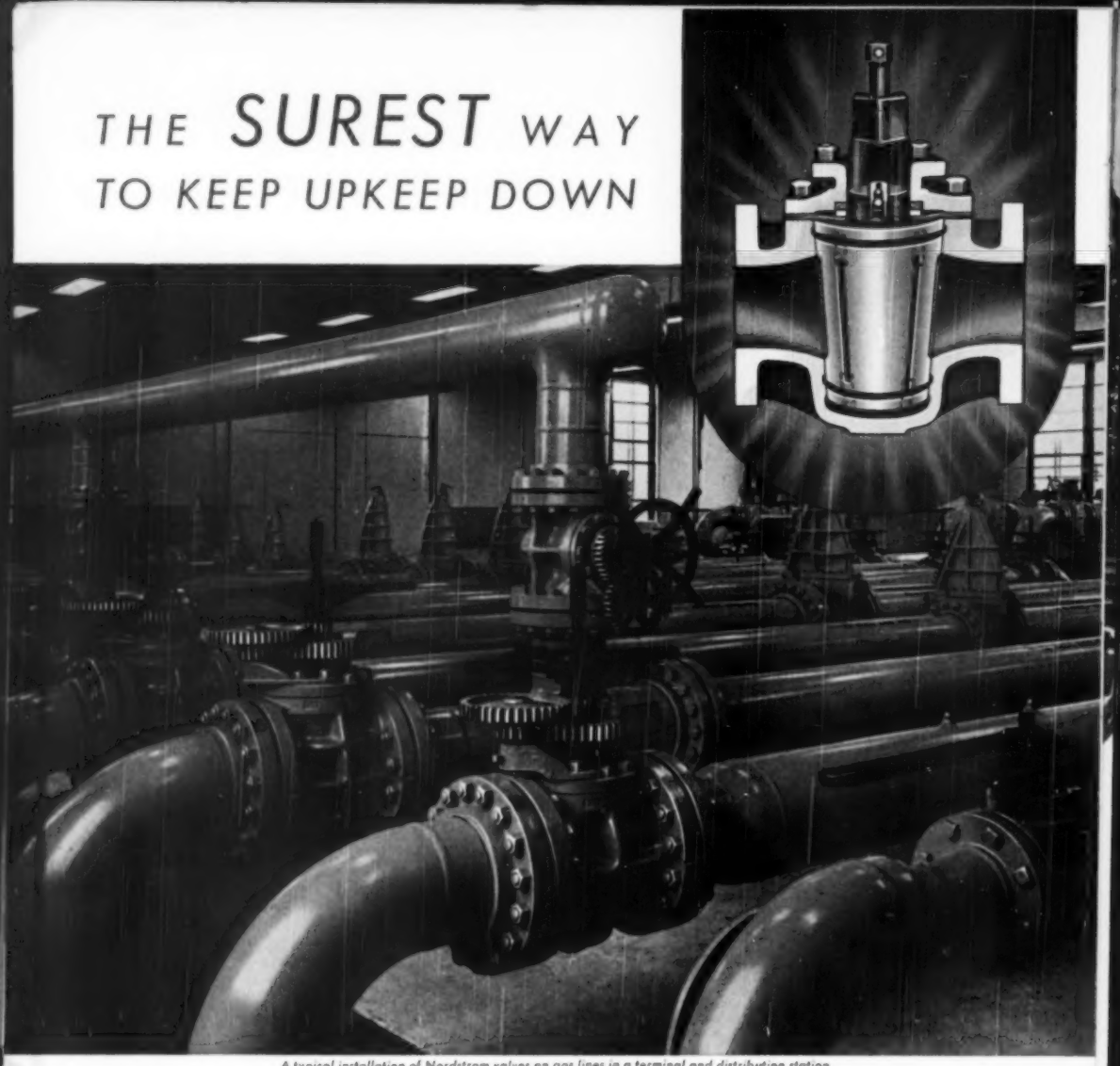
Need More Data?

For additional information on New Equipment items or literature mentioned in this section, use the coupon on reverse side.

Prompt action is suggested so that data will be readily available.


Set your sights on
VALVE PERFORMANCE
at its best—
NORDSTROM
UNSURPASSED IN EASE OF OPERATION
UNRIVALLED IN SHUT-OFF AND SAFETY
UNEQUALED IN LOW UPKEEP COST
Nordstrom VALVES
NOW...AUTOMATICALLY LUBRICATED WITH HYPERMATIC

THE SUREST WAY TO KEEP UPKEEP DOWN



A typical installation of Nordstrom valves on gas lines in a terminal and distribution station.

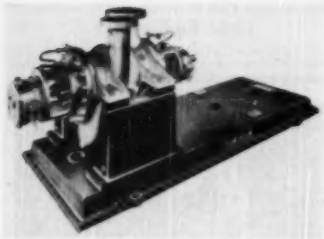
20-year average OF NORDSTROM PARTS REPLACEMENTS

less than ½ of 1% of valve purchases

In a recent audit of sales of Nordstrom valves extending back over a period of 20 years it was found that the ratio of repair and replacement parts was less than ½ to 100. Replacement parts were principally for valves in highly erosive services and for high temperatures where drastic conditions prevail. In other words the repair parts have over a period of 20 years equalled 46c to each $100.00 worth of valves purchased. This is indicative of the amazing low cost of upkeep as compared with other types of valves requiring frequent renewal of seating parts, packings, stems and occasional re-welds. *Nordstrom repair parts over a period of years are about one-tenth cost as compared with other valves.*

Nordstrom VALVES

Nordstrom Valve Division
ROCKWELL MANUFACTURING CO.
400 N. Lexington Ave., Pittsburgh 8, Pa.
District offices in all principal cities



only one moving and one stationary part. The "Koke-Krusher," Type CK, has a patented crushing mechanism located in the suction chamber immediately in front of the impeller eye. The only moving part, which is keyed to and turns with the pump shaft, has multiple spiral rows of integrally cast, radically extended, hardened cutters.

Self-Priming Pump

14 Allis-Chalmers Manufacturing Company's improved self-priming centrifugal pump, which, is claimed, will not bind or vapor lock, is described in Bulletin 52B6319-C. Principle of operation, selection data, and applications are included. The unit has 10 major parts.

Vapotester

15 Approved by Underwriters' Laboratories, Davis Emergency Equipment Company's Vapotester reads zero gas or vapor to the lower explosive limit. It operates on the principle of the Wheatstone bridge circuit.

Fire Killer

16 American - La France - Foamite Corporation's Foamite Airfoam is a stable, cohesive, free-flowing, protein-base foam fire extinguishing agent. The solution contains 6 percent Foamite Airfoam Liquid and 94 percent water. The Airfoam liquid is composed of a specially treated protein of vegetable origin together with additives which control the viscosity, lower the freezing point, improve the foaming properties, and control bacteria. Literature is available.

Work Clothing

17 Savings as high as $100 a year per man can be realized by using industrial work garments made with Union Carbide and Carbon Corporation's Vinyon N yarn, according to Chem-Wear Corporation, manufacturers of the clothing. Chem-Wear garments are claimed to outwear others 10 to 1. Coveralls, lab coats, matched shirts and trousers, jackets, and bib overalls in conventional sizes are available.

Electrode Holder

18 Both tong and hole type holders are combined in the Lincoln LJ-1, a new insulated electrode holder of The Lincoln Electric Company. The holder's small size is said to be ideal for operation with heavy gloves, in corners, and other confined areas. The holder is manufactured in the 250-ampere size for 1/16 to 3/16 inch electrodes. The cam jaw construction, open to one side, gives one position, 20 degrees off vertical for downhand welding, and a second position, 30 degrees off horizontal for overhead welding. The tip of the jaw end is covered with a new, high temperature resistant, asbestos base compound, said to be highly flexible. A hole in the jaw is for holding 18-inch center-grip electrodes.

New Equipment

(For additional information or literature check item numbers on mailing coupon, page 191.)

Banding Calculator

19 A dial-type calculator for use in determining the test type of metal for banding insulation under any given corrosive condition is offered by A. J. Gerrard & Company. On the reverse side, the calculator provides data for quickly determining length and weight of strap required for any banding application.

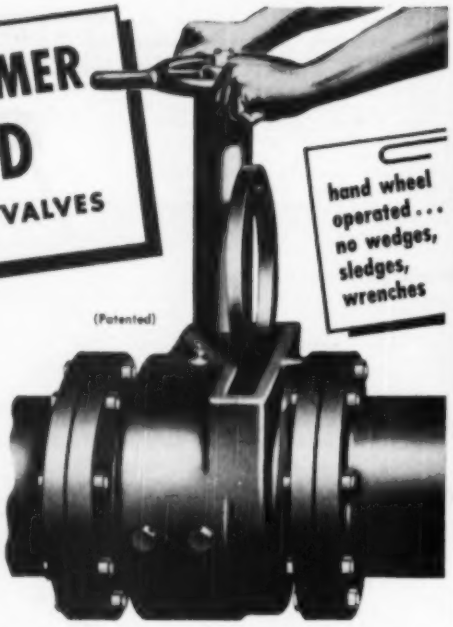
Headrest Goggles

20 The "free-floating" headgear long used on American Optical Company welding helmets has been adapted to a new headrest goggle for gas welders, cutters, burners, brazers and furnace men. Noviweld or Noviweld-Didymium lenses in several shades are

New HAMER RIGID LINE BLIND VALVES

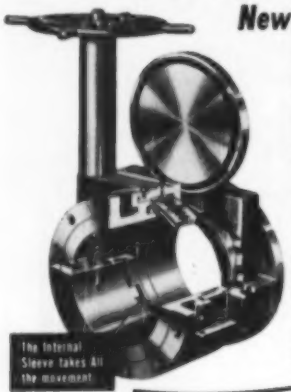
hand wheel operated . . . no wedges, sledges, wrenches

(Patented)



POSITIVE SHUT-OFF BY ONE MAN IN ONE MINUTE *without pipeline movement!*

Hamer RIGID Line Blind Valves solve the problem of effecting a positive blind shut-off in piping installations where endwise movement of the line is impossible. Now, for the first time, the advantages of the safe, speedy, one-man operated Hamer system of blinding can be incorporated in rigid pipe lines and manifolds in refineries, process plants, and on ship board, as original equipment in new installations, or as replacement of existing valves.



New Internal Expansion Feature

Face-to-face dimensions of Rigid Line Blind Valves conform to A. S. A. Standards for steel wedge gate valves and are not changed when releasing or sealing off the spectacle plate. An internal sliding sleeve, actuated by a ball-bearing mounted ring gear, takes all the movement and eliminates spreading the line.

Examine the cross section and you'll see these other important features. • *Enclosed plate slot*—eliminates loss of product, mess and fire hazard for fluid can't spill while plate is being reversed. • *Rigid body*—unaffected by misalignment or line strains. • *All working parts enclosed*—packed in grease for smooth action; sealed against line fluid. • *Positive shut-off or full-open fluid passage*—There's nothing like a Hamer Line Blind Valve for positive action, easy operation, long service and SAFETY.

SEND FOR CATALOG

There is a Hamer Line Blind Valve for every blinding application. Illustrated below: 1—Spool-Type, side mounted hand wheel. 2—Spool-Type, upright handwheel. 3—"Tee" and "Ell" Line Blind Valve. 4—Economy 3-Bolt Type.

HAMER LINE BLIND VALVES
Non-Stick PLUG VALVES
OIL TOOL COMPANY
2919 GARDENIA AVENUE, LONG BEACH 6, CALIFORNIA

New Equipment

(For additional information or literature check item numbers on mailing coupon, page 191.)

available. Replaceable cover lenses are provided for protection. Designed for wear over eyes or glasses, the goggles have well ventilated, indirect side shields to keep out sparks, metal splashes and stray light rays. A slight twist of a knob adjusts the goggle to the wearer's head size, and a "flick of the wrist" removes it. Bulletin S895.

Halide Meter

21 For the toxic range analysis of halogen derivatives of hydrocarbons, The Davis Emergency Equipment Company, Inc. is offering the halide meter. This analyzer employs a photo-electric photometer to indicate changes in the intensity of the blue spectrum of a copper arc discharge in the presence of organic halide vapors. Dimensions of the portable 35-pound instrument are 15 by 16 by 9¾ inches. Operation is on 110-volt, 60-cycle current.

Surface-Active Agents

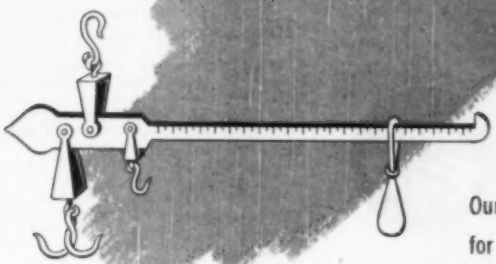
22 "'Tergitol' Surface-Active Agents," a folder, is available to manufacturers in the wet-processing industries from Carbide and Carbon Chemicals Division, Union Carbide and Carbon Corporation. Properties, uses, and specifications of "Tergitol" wetting agents 7 and P-28 and of "Tergitol" penetrants 4, 08, and EH are included in a folder as are data on average wetting times for the different products in various acid, base, and salt solutions and information on the effects of organic solvents on wetting time.

Also offered is a technical data sheet on the new "Tergitol" dispersant TMN-650, a surface-active agent of the non-ionic type, which is said to be a 100 percent active product compatible with anionic, cationic, and non-ionic surface-active agents.

Indicating Pyrometer

23 Wheelco Instruments Company has developed a compact new indicating pyrometer, Model 192, for flush and surface mounting. With front dimensions of 7½ inches wide and 5 inches high, the indicator is said to be

How "heavy" is resourcefulness?



Ours would weigh nearly four billion pounds, for that's how much Attapulgus Fullers Earth and Porocel Activated Bauxite we've shipped to petroleum refiners.

When weighing resourcefulness—as it applies to percolation adsorbents and solid catalysts—two factors are particularly meaningful: First, the desire of all the people in the company family to tackle problems that require particular skill and broad technical knowledge. Second, the company's physical reach—mines, plant equipment, specialized laboratory and engineering facilities—for good men can do no more than their tools permit.

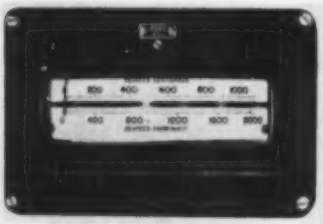
These resources abound at Attapulgus and Porocel. They dovetail to put a firm base under a completely integrated service. And—for world-wide petroleum refining—to put the right adsorbents to work under the right conditions.
May we be of service to you?

ATTAPULGUS CLAY COMPANY *Fullers Earth* · **POROCEL** CORPORATION *Activated Bauxites*

Dept. W, 210 West Washington Square, Philadelphia 5, Pa.

New Equipment

(For additional information or literature check item numbers on mailing coupon, page 191.)

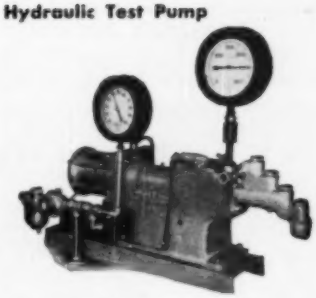


ideal for use by manufacturers of smaller type heating equipment, such as laboratory furnaces as standard built-in accessory. The high resistance "edgewise" movement with Alnico V magnet and wide open mirrored scale is fully compensated and enclosed in a dustproof housing. Bulletin D302-5 gives further information.

Bulk Station Pump

24 Capacities to 600 gpm., discharge pressure to 75 psi., and temperature range to 150° F. are featured in Byron Jackson Company's new mechanically-sealed BJ Type TLB bulk station pump for handling gasoline, butane, stove oil, diesel fuel, naphtha, kerosine, lubricating oils, solvents, thinner, and other hydrocarbons. The unit is single-stage, single-suction, and close-coupled to an explosion proof motor. Bulletin No. 50-9200 gives details.

Hydraulic Test Pump



25 Double ball-check liquid ends that are self-cleaning and non-clogging and that completely eliminate air binding and wire drawing are featured in Milton Roy Company's new "aiROYmetric" pump which can be set to build up any desired hydraulic process pressure up to 25,000 psi. Pump is operated at full stroke length and maximum strokes per minute until the predetermined hydraulic pressure in the system is approached. Then the pump automatically slows down to the strokes per minute necessary to maintain the required hydraulic pressure in the system. Maximum capacities to 405 ghp. at lower pressures can be secured. Bulletin No. 450.

Pipe Price Card

26 A new data card designed as a help in purchasing carbon steel pipe or estimating cost of apparatus using this material, has been issued by The Babcock & Wilcox Tube Company. Identified as TDC 135, the card tabulates the present day prices per hundred feet of seamless carbon steel pipe 1½ inches in nominal diameter and smaller, in all quantity brackets. Also indicated are prices for standard weight (schedule 40), extra heavy weight (schedule 80), and double extra weight pipe.

Heat Resistance

27 "Stainless Steel for Heat Resistance," published by Armco Steel Corporation, discusses the properties of stainless steel and outlines the proper grades to use for parts subjected to heat. Graphs show the relative scaling resistance, high temperature tensile strength, creep strength, and high temperature rupture strength of the various stainless steel grades. A section gives distinctive characteristics of each grade of chromium-nickel and chromium stainless and indicates the type of service for each.

Pipe Fittings

28 A fitting to connect black or galvanized pipe without threading of the pipe ends is manufactured by Union Products Company of Minneapolis. Fittings are made of steel with soft metal seals for ⅛ to 1¼-inch pipe in tees, couplings and elbows.

Differential Sender

29 Hagan Corporation's meter type differential master sender, a pneumatic machine used as the metering element in the measurement and control of steam, gas and liquid flow, liquid level, pressure differential and similar

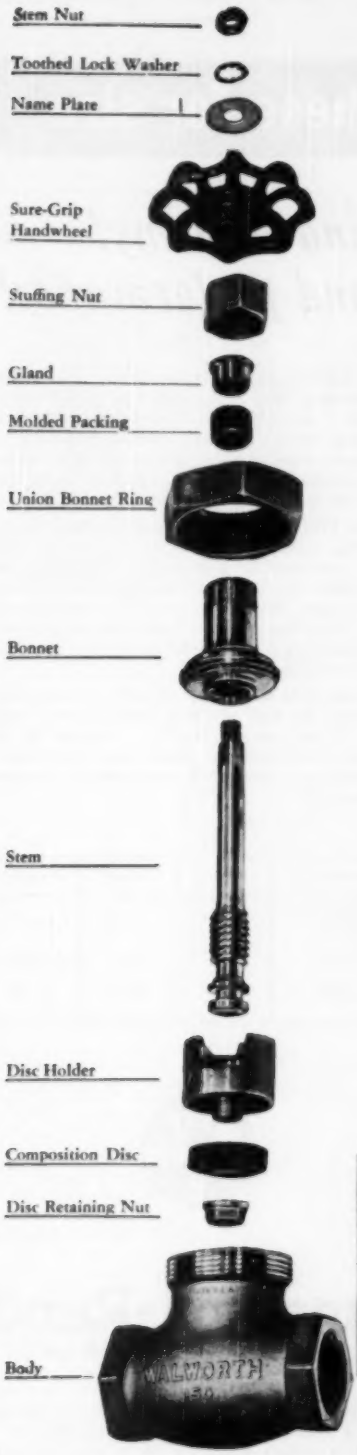
Close fractionation of hydrocarbons and high liquid output are operating features of TULSA TYPE Fractionating Columns.

TULSA TYPE is designed and fabricated to meet your specified operating conditions.

— Write for General Catalog —

FLINT STEEL CORPORATION

TULSA, OKLAHOMA



TO MAKE A GOOD VALVE BETTER

Walworth has redesigned and improved its No. 95 Quality Bronze Globe Valve.

150 pounds working steam pressure at 500F

300 pounds cold water, oil, or gas.

Can be repacked under pressure when fully opened.

The Walworth No. 95 Bronze Globe Valve has always been tops with piping men because they liked these features: Renewable composition disc; lock-on, slip-off disc holder; union bonnet construction; deep stuffing box; tough bronze body made of Composition M (ASTM B61).

Now Walworth has added these improvements: (1) New cylindrical disc holder that accurately guides the disc to the seat, regardless of the position in which you install the valve. (2) Newly designed, air-cooled, sure-grip handwheel that you can grab and turn, even when wearing greasy work gloves. It has a tapered square hole sized to gage to fit snugly on the finished square of the stem. (3) Toothed lock-washer to prevent the stem nut from becoming loose. (4) All parts have been redesigned to give maximum service and strength.

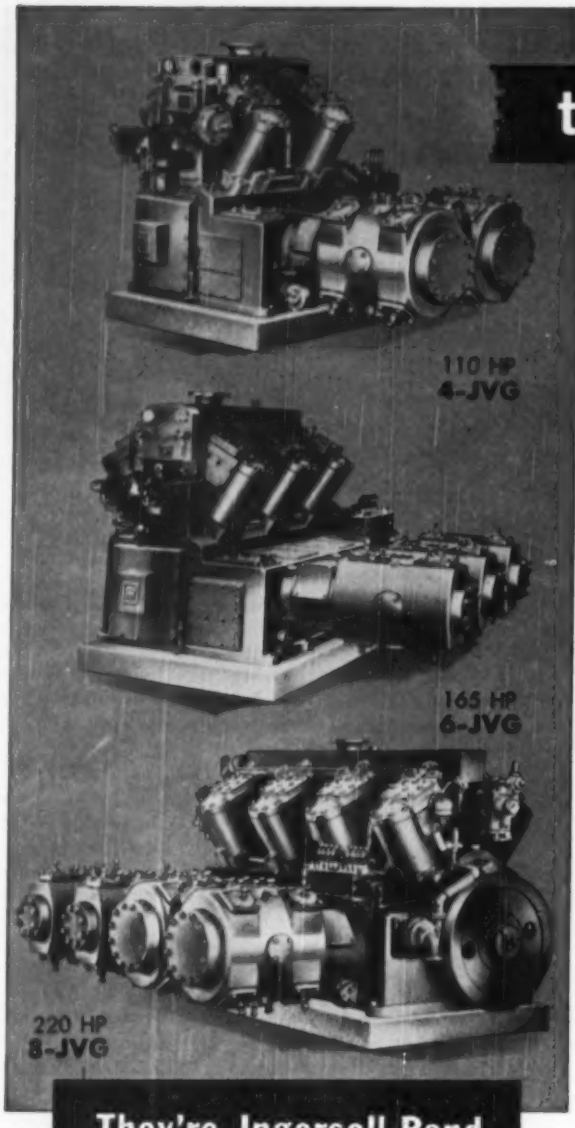
Walworth Quality Bronze Valves are available in Globe (No. 95), Angle (No. 96), or Check (No. 97) types and in sizes from ¼ to 3 inches (check valves ¼ to 2 inches). Ask your Walworth distributor to show you the improved Walworth No. 95 Bronze Valve, or write for further details.

WALWORTH

valves and fittings

60 EAST 42nd ST., NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD



try these for size

...and economy!
...and performance!

The light-weight, gas-engine-driven JVG is now available in three sizes ... 110, 165, and 220 horsepower ... for refinery or oil field service. Excellent running balance of these Ingersoll-Rand 4-cycle V-angle compressors, needing only small foundations, makes them ideal for skid mounting and jobs where frequent relocation is necessary.

The JVG is designed for maximum flexibility of loading, to meet any pressure conditions ... any gas ... any service. Maintenance men and operators praise its heavy-duty construction, economy of fuel and lube oil, and simplicity and compactness. They also like the perfect combustion and smooth, quiet 4-cycle operation under all load and speed conditions.

These units will meet your most exacting specifications for high efficiency, conservative rating, long life and low maintenance ... whether the job be for semi-portable use or permanent installation. Consult your nearest I-R representative for complete details.

Horsepower	Width	Length	Height
110	6'-2"	8'-5"	6'-3"
165	8'-3"	8'-5"	6'-3"
220	10'-4"	8'-5"	6'-3"

They're Ingersoll-Rand
JVG
GAS-ENGINE-DRIVEN
COMPRESSORS

4-CYCLE

Ingersoll-Rand
11 BROADWAY, NEW YORK 4, N. Y.

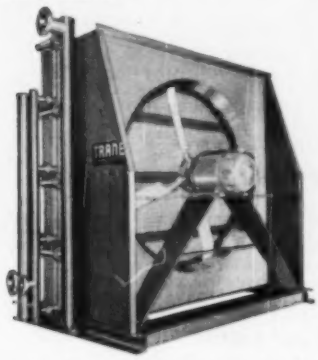
522-6

COMPRESSORS • AIR TOOLS • CONDENSERS • ROCK DRILLS • TURBO BLOWERS • CENTRIFUGAL PUMPS • OIL & GAS ENGINES

Types XVG, SVG and KVG gas-engine-driven compressors are available for installations requiring larger horsepower ratings.

applications, is described in Bulletin 2150. The sender is characterized by instantaneous response to all changes in applied differential and provides precise measurement over a continuous range from 50 inch water column to 150 psi at static pressures up to 2500 psi.

Fluid Cooler



30 Development of a complete line of 22 standard production dry type fluid coolers has been announced by The Trane Company for use primarily in air-cooling engine jacket water and lubricating oil in diesel, gasoline and gas power plants. Basic design consists of a cooling core, propeller fan, and heavy-duty casing. Cooling capacities range from 66,250 to 7,630,000 Btu per hour. Weights range from 325 pounds to 9¼ tons. The smallest unit, with an 18 inch, one hp. fan, will handle 2200 cubic feet of air and a flow of 20 gallons of water per minute. The largest standard unit, with a 144.1, 34 hp. fan, will handle 220,000 cubic feet of air and a flow of 1000 gallons of water per minute. Bulletin DS-395.

Compressor

31 A new line of Ingersoll-Rand gas-engine-driven compressors, available in 110, 165, and 220-hp., consists of 4, 6, and 8-power cylinders, respectively, having an 8¼-inch bore, a 9-inch stroke, and 2-power cylinders for each compressor frame. The JVG is a small, compact compressor of the I-R, 4-cycle, V-angle design, having the power connecting rods articulated with the compressor rods. Form 3127-A, which contains a cross-sectional view and details pertaining to construction features, also lists uses.

Recorder-Controller

32 Gotham Instruments, Division of American Machine and Metals, Inc., announces a program recorder-controller, shown with door open, which eliminates cam-cutting, and uses interchangeable parts. A set of standard cams make it possible to change the rate rise, the length of hold, and the holding temperature or pressure without cutting a cam for each cycle or going to the trouble of removing or inserting different cams. The holding temperature is

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Return to P. O. Box 2608 Houston 1, Texas

New Equipment

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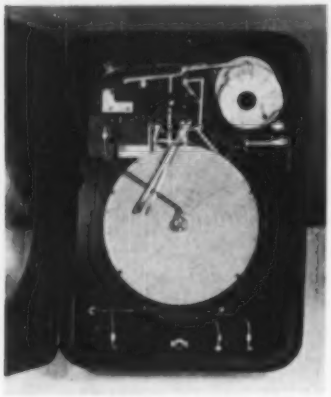


changed by turning a knob for setting control temperature. The recorder has a 9-inch chart.

Outdoor Flood Light

33 Claimed to be unaffected by submersion in water, Mattox Machine Company's new waterproof all-weather outdoor flood light is efficient in the temperature range from minus 100° F. to 500° F. The new Dow 250 Silicone has been utilized in the development of the lamp which is used with 300, 500, 750 and 1000-watt bulbs of standard thread size. The lamp weighs 1.6 pounds, and can be locked in any position. An attachable shade reflects any direction, extends four inches beyond the globe, and can be trimmed to any desired length.

Atom Chart

34 "Chart of the Nuclides," 2nd edition, of General Electric Company's research laboratory, lists over 1000 kinds of atoms known at the beginning of the year. Data for each isotope include the proportion that it normally constitutes of the natural element; if radioactive, the speed at which it decays and the radiations emitted; whether it appears as a product of the fission of uranium 235; and an important technical datum known as the "thermal neutron absorption or activation cross section." For radioactive isotopes the speed of decay and the radiations emitted are given.

The revision over 1948's edition was made by Dr. John R. Stehn of the Knolls Atomic Power Laboratory which G. E. operates for the atomic energy commission.

Flow Indicators

35 Selas Corporation of America flow-rate indicators for air and gas (May PR, page 214-15) are described in Bulletin SC-4.1. Included are installations and applications, construction and operation, and selection data as well as photographs of the applied instruments and a cross-section diagram.

Refinery Pumps

36 Ingersoll-Rand Company Form 7212 describes a new line of cradle-mounted centrifugal pumps, known as the CRVR for process and refinery service. Included are a sectional view of the pump with important features described. Dimensions and specifications are also given. Four pump sizes are 1, 1½, 2, and 3 inches for capacities from 20 to 550 gpm. and total heads up to 250 feet.

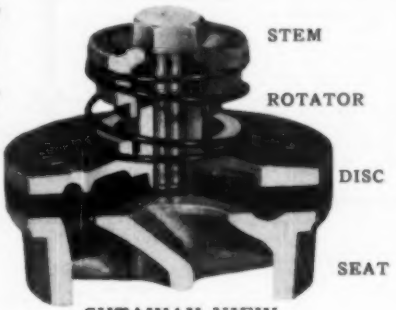
Steam Cleaners

37 A list of possible sources of coil scale build-up in steam cleaners is given in a booklet offered by The DuBois Company. A schematic diagram illustrates operating principles. Also included are suggestions for obtaining efficiency and economy in maintaining equipment and compound recommendations for types of cleaning jobs.

Water Cooler

38 Young Radiator Company's Mono-weld heavy duty engine jacket water cooler No. 79095 has a copper front guard screen with 1-inch mesh and a copper fan guard screen with 1-inch mesh. An aluminum fan is

HOW SIMS VALVES INCREASE CAPACITY OF YOUR PUMP



CUTAWAY VIEW

SIMS Inclined **PORT** Seat design minimizes fluid flow resistance which allows complete filling of pump cylinders at higher pump speed when handling a volatile or viscous liquid. Valve Disc rises and falls evenly to give smooth dependable operation.

SIMS Rotating **DISC** guarantees even wear and long life with a tight leakless valve without facing off, grinding in and time out for repairs. The flat face of the disc avoids flow resistance due to concave surface.

SIMS ROTATOR action combines with the action of the Seat and Disc to give reliable rotation of the Disc. The long wearing surface guide reduces wear of parts and prevents cocking of the Disc.

SIMS valve **STEM** is protected against breaking by double Dash Pot cushions in the Stem Head and on hub of Rotator. The Spring Guards on Stem and Rotator protect Spring against jamming of coils and breaking.

These parts and features combine to safely permit a 20 to 50% increase in speed, thereby achieving an increase in capacity with quiet smooth operation.

Write for catalog and name of agent nearest you.

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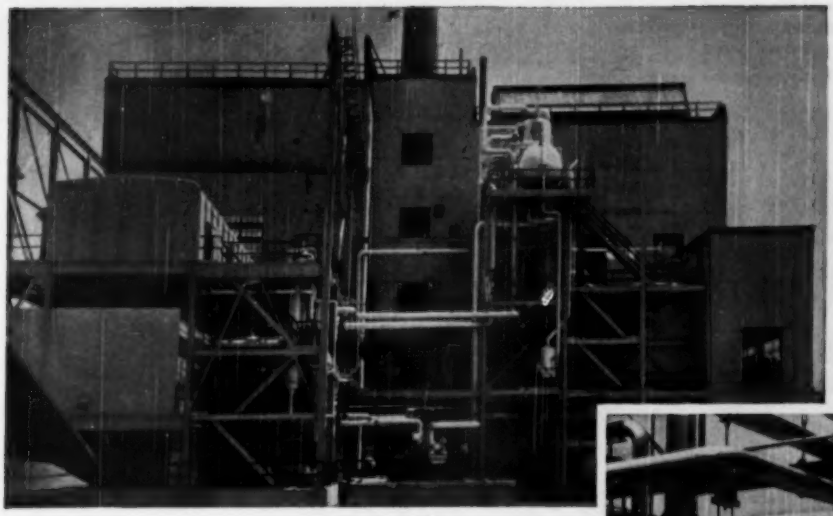
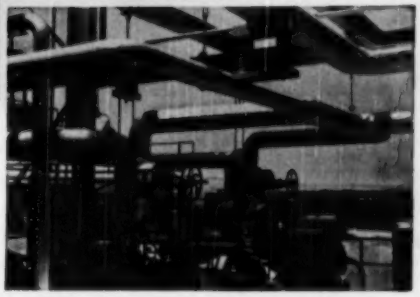


Engineers,
Stone & Webster
Engineering Corp.,
Boston, Mass.

Insulation Contractor,
Willard A. Sells, Inc.,
El Paso, Texas



El Paso Electric Company efficiently conserves heat with K&M INSULATIONS

IN 1948, the El Paso Electric Company extended its Rio Grande Power Station to add 20,000 Kilowatts to the existing plant's 46,000 Kilowatt capacity. Boilers, piping, and other heated surfaces were insulated with K&M "Featherweight"® 85% Magnesia for temperatures up to 600° F., and with K&M Hy-Temp Combination for temperatures in excess of 600° F.

K&M "FEATHERWEIGHT" 85% MAGNESIA

for temperatures to 600° F.

For more than 60 years K&M "Featherweight" 85% Magnesia Insulation has demonstrated its ability to conserve heat efficiently in power plants, oil refineries, chemical plants, factories, steamships and hospitals. In fact, wherever exacting requirements must be maintained for temperatures up to 600° F., "Featherweight" 85% Magnesia can be used with complete confidence. It combines the high insulating qualities of basic carbonate of magnesia with clean asbestos fiber as the binding element.

K&M HY-TEMP COMBINATION

for temperatures to 1900° F.

K&M Hy-Temp Combination Insulation is used for temperatures in excess of 600° F. and up to 1900° F.; combines the greater insulation efficiency of "Featherweight" 85% Magnesia with the high heat resistance of Hy-Temp.

Your K&M Distributor will be glad to give you complete information on K&M "Featherweight" 85% Magnesia Insulation, K&M Hy-Temp Combination Insulation, or other insulations in the K&M line. Or, write us.

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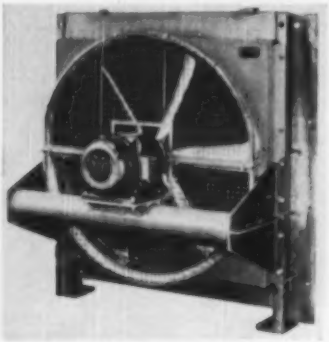


shrouded with aero-dynamically designed venturi type opening for high air delivery with minimum resistance to air flow. The fan is mounted on output shaft of a 5-hp., 1140-rpm. motor. A fan air blast opens shutter blades which remain open until fan stops, at which time gravity and the shutter blade unbalance close the shutter blades tightly against each other.

Flexible Tubing

39 "Spiratube," a flexible tubing for ducting of air and other gases, solids, liquids at low pressure, offered by Flexible Tubing Corporation, has a basic design consisting of a preformed continuous spring wire helix secured within overlapping plies of spirally wound fabric. Coating may be natural rubber, buna N or S, thiokol, polybutadiene, silicone, vinyl, or a polyblend. Four standard types of Spiratube are available as are special fittings. Protective boots are individually designed to protect moving parts from dust, grit, and other matter.

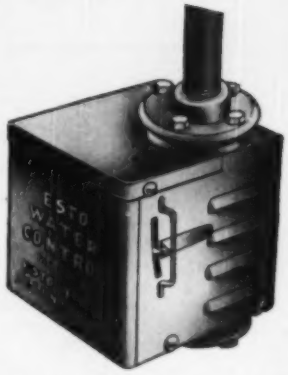
Humidicator

40 Relative humidity by the wet and dry bulb method can be determined by Weston Electrical Instrument Corporation's "TAG" pocket humidicator Model 8704 which can be hand-used or mounted on a wall. A simple built-in psychometric slide rule converts the wet-bulb and dry-bulb reading direct into relative humidity, eliminating charts or tables. The device consists of two etched scale glass thermometers which are individually hand-calibrated and secured in a white plastic case by integral resilient mountings.

Fittings

41 Seamless carbon steel welding fittings and forged steel flanges are described in Grinnell Company, Inc.'s Catalog Wi-1950. Included are standard schedules with their specifications, and sizes; data on dimensional tolerances; American standard flange facings with dimensions; thread standards and threading practice; service pressure ratings; and physical and chemical requirements for flanges, nuts and bolts. Also given are sizes and wall thicknesses of welding fittings stocked in various other metals.

Water Control



42 Electric Chemical Supply & Engineering Company announces a new electrically controlled safety device to protect water-cooled, electrically-operated equipment, such as air compressors and vacuum pumps against damage through water failure. The Esto water control can be adjusted to operate at any water flow the equipment requires, eliminating the possibility of overheating. If the water supply fails, a weighted lever falls which opens the circut and the relays stops the equipment or sounds an alarm or both. The controlled compressor will not start until the water has been turned on.

Refractory Products

43 Lacled Christy Company's line of refractory products, described in Bulletin No. 128A, includes cements and mortars, plastics, castables, coatings, fire brick, silica, acid proof, and insulating brick. The booklet contains data on softening point; containers; air or heat set; pounds per 1000 brick; weight per cubic foot, acid or neutral classification; and uses. Other information includes quantities of fire brick required per square foot, estimating weights, mortar or high temperature cement required per thousand new fire brick, etc.

Pressure Transformer

44 For measuring differential pressure for indicating, recording and controlling the rate of flow of steam gas or liquid fuel, water and other materials, Hagan Corporation offers a differential pressure transformer with pilot valve construction; described in Bulletin 2250. Differential measuring range is 100 inches water column to 25 psi. at static pressures up to 300 psig. The self-aligning pilot valve has only one moving part. Transformer may also be used as a liquid flow meter, particularly suited for measurement of tar or fuel-oil flow. No sealing pots or separating chambers are needed.

Wafer Type Valve

45 One-piece body casting valves, developed by R-S Products Corporation, designated as No. 771, is a heavy-duty, wafer-type valve equipped with handwheel control self-locking worm and gear. Vane, shaft assembly and handwheel control are identical with

WIRE MESH

Maybe it all *does* look pretty much the same at first glance. But when a firm has been making wire mesh for 70 years man and boy, there's bound to be a little more to it than meets the eye —a little more know-how in engineering and weaving, a little more quality in the product, a little more service and satisfaction to the user.

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Aiming for higher octanes?

See how THIS Mercaptan Removal Process replaces doctor treating

AND

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- *requires a minimum of new equipment*

More than seven years of commercial refinery operation have proved conclusively the high efficiency of the Tannin Solutizer Process* for mercaptan removal. This is the process that brings your equipment up to "new plant" standards in the economical treatment and blending of higher octane gasolines, *without* affecting the stability of the treated product.

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Operating economy is an outstanding advantage of the Tannin Solutizer Process. Still another important consideration . . . *this process is not corrosive;* does *not* require equipment of special alloys.

Complete engineering service is available . . . to help plan your unit, to supervise start-up, to assist in later operation if required. We welcome the opportunity to work with you in achieving the many benefits of the Tannin Solutizer Process.

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SHELL

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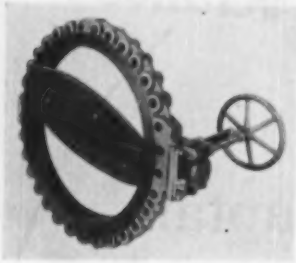


the double flanged valve. Flarecut on body casting accommodates large mounting bracket base. In the open position, the beveled streamlined vanes create a Venturi action. Face-to-face dimension does not reduce torque.

Work Suits

46 Catalog Section 12005 describes work suits offered by The B. F. Goodrich Company which are made both with rubber and with Koroseal and have leak-proof vulcanized seams.

Steam Traps

47 W. H. Nicholson & Company's five types of thermostatic steam traps for pressures to 225 pounds are explained in Catalog No. 250. Included are two types of expansion steam traps for pressures to 250 pounds; three types of weight-operated traps for steam air, gasoline, pressures to 650 pounds; and three types of steam air, and gas separators. Also given are capacity tables, installation diagrams, charts and formulae for determining the proper size trap.

Rotating Equipment

48 "Care of AC Rotating Equipment," Booklet O5R7417 of Allis-Chalmers Manufacturing Company, is broken down into preventive maintenance and machine repairs. Included are drying moist insulation, measuring insulation resistance, bearing clearances and proper machine applications. Machine repair covers data on stator coil and slip ring rotor repairs and balancing of rotating equipment.

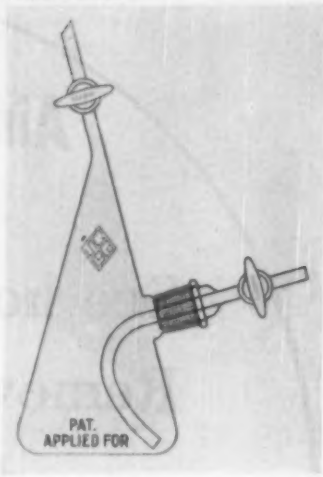
Cast Iron Tubes

49 Bulletin No. 169 of The Green Fuel Economizer Company, Inc., describes Premier Diamond Economizers with cast iron and steel tubes. Included are advantages, typical arrangements, diagram of construction, etc. A cross-section drawing shows staggered tube arrangement which is not over six tubes high per tier.

Refinery Construction

50 A 16-page booklet about cost control and price responsibility in the engineering and construction of refineries and natural gasoline plants, has been published by Refinery Maintenance Company, Inc., Compton, Calif.

Flask Funnel



51 Stopcocks of "Pyrex brand glass are featured in Scientific Glass Apparatus Company, Inc.'s new Hustinx, heatable flask-separatory funnel. In analysis by extraction, all operations are carried out in the same flask. In drawing off light liquids, a heavy liquid is introduced through the side tube until the light liquid is expelled through the stopcock at the top. The funnel may also be used for determining the fatty acid content of soaps and for operations which must be carried out in the presence of an inert gas.

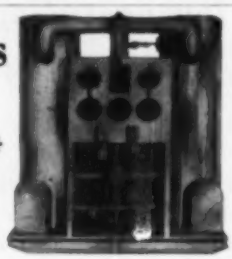
Lined Drums

52 Schori Process Division of Ferro-Co Corporation is offering polyethylene-lined 30 and 50 gallon Hackney open-head seamless barrels. The polyethylene lining is 1/32 or 1/16 inch thick. Drums so lined with the flame spray process, shown herewith, are said to eliminate the high damage potential of crocks and glass vessels to personnel and equipment.

Vacuum Pump

53 Model CVD 3534, a vacuum pump of Kinney Manufacturing Company, displaces free air at 4.9 cubic feet per minute (139 liters per minute) and operates with a 1/3 hp. motor. No warm-up period is required, according to the firm. The instrument is 16 inches high and employs the oil-seal pumping system. Double sealing-oil res-

Pritchard's
New
HYDRYER*



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Pritchard HYDRYERS are unexcelled for efficiency and dependability in drying air for instrument and process controls. Standard packaged units are designed to reduce dew points of compressed air and other gases to minus (—) 40° F. No special installation required. Specially designed units may be built to your requirements.

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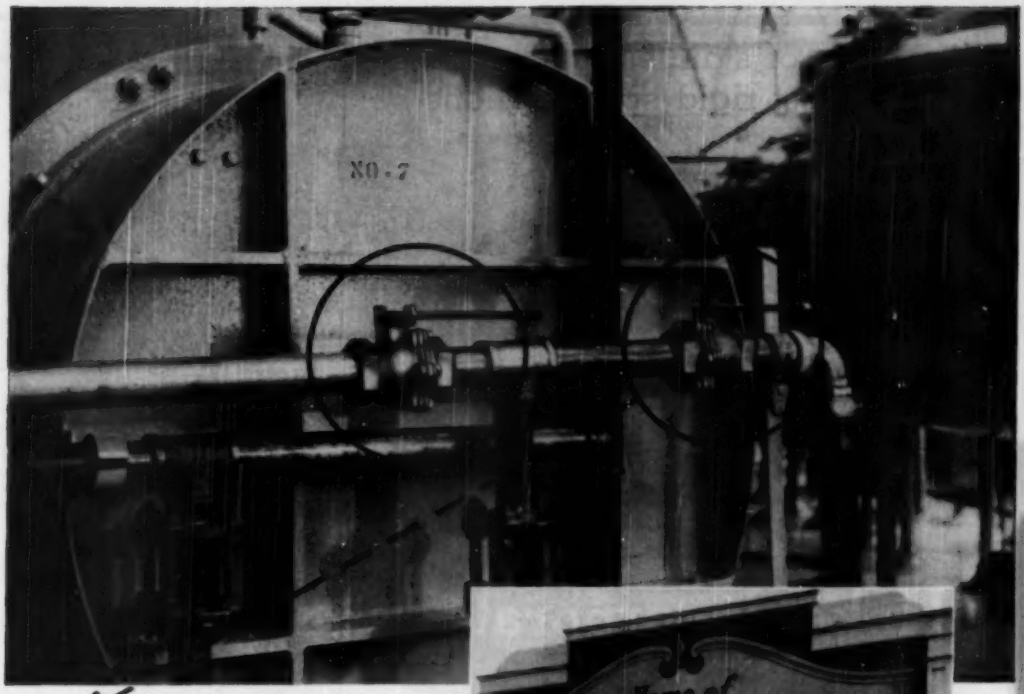

fine cocktails

produced faster with rockwood ball valves

Until G. F. Heublein & Bro., Inc., of Hartford, Conn. switched to Rockwood Ball Valves for use on their Club Cocktails filter machine, it was necessary for them to replace their old valves every six or seven months. During that period the maintenance cost for keeping these valves in working condition ran high.

The two 1½" Rockwood Ball Valves shown above are opened and closed approximately 50 times a day and have been in operation for over nine months without any maintenance. Foreman of this cocktail department says, "The Rockwood Ball Valves operate easier and do not bind or stick when opened or closed. Because of the trouble-free service we have been getting from the Rockwood Ball Valves, we have greatly increased our Club Cocktails production."

Words like these from men who know prove that Rockwood Valves are better designed and engineered to handle your piping requirements.

Today, Rockwood Ball Valves are giving outstanding service in chemical, food, paper, textile and other process plants, oil refineries and many other types of industries.

Made in bronze with screwed ends in all pipe sizes from ½" to 2" for 300 p.s.i. working pressure.

Send in your order today. Distributors in all principal cities.

SEVEN OUTSTANDING FEATURES

- Full round open area - no turbulence in fluid stream.
- Leak proof after continued use.
- New floating ball - resists pitting, scratching & abrasion.
- No exposed seating surface in open or closed position.
- Easy to open or close under full pressure.
- Installed in any position.
- Quarter turn (90°)opening and closing valve.

ROCKWOOD SPRINKLER CO

102 HARLOW STREET WORCESTER 5, MASS

it's made of stainless steel
to the most rigid specifications

PRESSURE SAMPLE CONTAINERS

ICC Approved

Invaluable for sampling liquids and gases

At last here are the Hoke Pressure Sample Containers standard pressure vessels made of stainless steel to the most rigid specifications.

This new Hoke product is proving invaluable for sampling of both liquids and gases. They are ICC approved and available in two standard service pressure ranges, namely: 400 psi and 1800 psi. Either double or single valving is obtainable. 18-8 Stainless Steel is standard material. Other metals, ferrous or non-ferrous, manufactured on special order.

Write for Folder P6 giving details and prices

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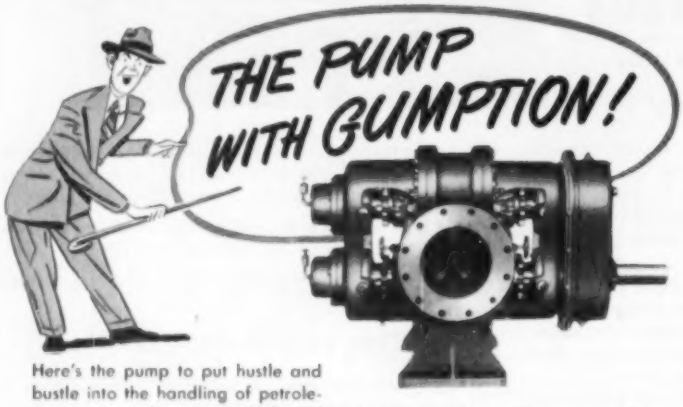

Here's the pump to put hustle and bustle into the handling of petroleum products. Kinney HQ Heliquad Rotary Pumps are tops for pumping speed and efficiency. They give you a full measure of work for the power you put into them. And best of all, Kinney HQ Pumps can take it! The average annual upkeep cost (by actual survey of 1685 pumps) is only 1.65%. Available plain or steam jacketed, in capacities to 3000 bbls. per hour. Write for Bulletin L-48; address Kinney Mfg. Co., 3596 Washington St., Boston 30, Mass. Branches in New York, Chicago, Cleveland, Philadelphia, Los Angeles, San Francisco, Seattle, New Orleans, Houston.

KINNEY Rotary PUMPS

New Equipment

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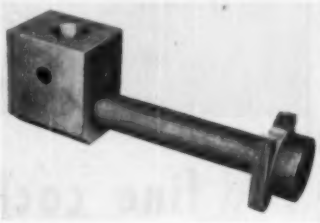
ervoirs provide continuous oil purification. On a blank test, each unit is required to produce McLeod gauge absolute pressure readings of 0.1 micron (0.001 mm Hg.) or better.



Steam Jet

54 The series FM-1A "Karbate" brand impervious graphite circulating steam jet, announced by National Carbon Division, Union Carbide and Carbon Corporation, is available in sizes 2 and 4 with riser assemblies up to 9 feet to 3¾ inches in height. The jets supplement the two types of "Karbate" impervious graphite heat exchangers which are used for indirect heating of open tanks. The riser is a graphite pipe fitted with a neoprene "Flexlock" gasket at the submerged connection to the jet and a type V flange connection to the other end. Catalog section M-9101.

X-Ray Service

55 Under "Maxiservice," a "packaged" X-ray service, offered by General Electric X-Ray Corporation, one monthly charge covers rental of equipment, instruction in its use, maintenance service, replacemnt parts, tubes, property taxes and interest costs without investment. The plan is offered for cost-reduction, quality control, and research. Literature on the plan is available from company headquarters.

Jet Cleaner

56 A high-pressure jet cleaner, manufactured by Sellers Injector Corporation, consists of a venturi-injector mixing chamber connected to a steam and cold water line, a 50-foot length of high-pressure hose, cleaning lance and special nozzle. A connec-

PAGE *Welding* ELECTRODES

a NEW line of Page-Allegheny AC-DC Stainless Steel Electrodes

they're NEW

... ***BUT*** they've been "given the works" by many large fabricators of stainless steel equipment—on the job. And, from all reports, they're the most all 'round satisfactory electrodes PAGE ever developed for any kind of weld on any type of stainless steel. And PAGE has been making stainless steel electrodes since the early development of stainless.

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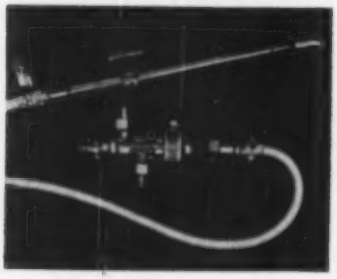


tion and control valve provide automatic addition of a detergent or solvent, if desired, in any proportion from 0 to 10 percent. The unit is small for wall or post mounting. It provides a high-temperature, large volume water jet at pressures adjustable up to more than twice the plant steam pressure. Bulletin C-3.

Fans

57 "Standards, Definitions, Terms and Test Codes for Centrifugal, Axial and Propeller Fans," National Association of Fan Manufacturers, Inc., includes information previously published in four separate bulletins. It also contains new tables on size standards for various types of fans and illustrations of revised fan arrangements. Classification or air-moving equipment, standards, terms and definitions in use by the fan industry, and standard codes for air and sound measurements are given.

Tubular Scaffolds

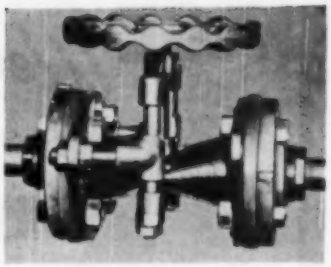
58 Tubelox scaffolding for use in refinery construction and maintenance work is available in lightweight high-carbon steel tubing or aluminum. The scaffolding is manufactured by The Patent Scaffolding Company, Inc., and consists of four basic parts: tubes, bases, and two couplers, standard and adjustable. Other scaffolds offered are a rolling type, a light duty midget safety swinging type and a "Trouble Saver" tubular steel sectional one. (Bulletin PTS-16.)

Vacuum Control

59 Cartesian Manostat No. 6 of The Emil Greiner Company is an automatic vacuum and pressure control for industry, pilot plant, and laboratory. Bulletin CM.97 which includes construction details and information on the instrument's operation in vacuum and under pressure tells how to regulate flow under pressure and in vacuum. Among applications explained are use of the by-pass for large systems.

Rubber Pinch Valve

60 Sizes range from 1½ to 12 inches in United States Rubber Company's new rubber pinch valve. The new valve is said to outwear metal when installed in pipe lines carrying abrasive or corrosive mixtures. Mechanism, retaining rings and pinch valve body are incorporated in one unit. Valves are available in abrasive and corrosive resistant compounds, neoprene for oil resistance, butyl rubber for high heat and severe acid conditions, and pure gum stock for food and beverage conveyance.



Nickel Resistance

61 Resistance of nickel and its alloys to corrosion by caustic alkalies is described in Bulletin T-6 of The International Nickel Company, Inc. Included are over 20 illustrations and 40 tables, methods and results of testing, instructions for descaling and cleaning, and maintenance welding. Nickel alloy irons and higher non-ferrous nickel alloys and pure nickel are discussed.

Blowers

62 The Standard Stoker Company's Bulletin 88 gives dimensional information for Standardaire blower, including engineering layout, typical application data, design data, blower number, and rating: cfm at listed rpm.

CONTROL BY AIR POWER

. . . with the Wheelco Pneumatic Capacilog! *For safety*—where electric contactors or motors are a hazard—*for results*—where fixed position changes of fuel or medium are injurious to your product.

Get instant indication, permanent record and control with the smooth-flowing power of air—get the Wheelco Pneumatic Capacilog.

Wheelco instru*mentality* adds safety and product uniformity.

Write for Bulletin C2, Wheelco Instruments Company, 701 W. Harrison Street, Chicago, Illinois.

wheelco electronic controls

SAVE INSTALLATION and Production Time on *Stainless* Piping

with FLOWLINE Stainless STEEL WELDING FITTINGS

FLOWLINE stainless steel welding fittings reduce the cost of installing a stainless piping system—because any system can be constructed with them simply by straight cutting of tubes to desired lengths and plain butt welding. Complicated "angle" cutting and fitting is eliminated; fewer welds are needed; and faster, uniformly sound welds are assured. A clean, lastingly efficient, trouble-free system is the result since pockets and sharp corners that cause erosion, product accumulation, and pressure drop are eliminated. *FLOWLINE* fittings can be cut out of the line and used again.

These fittings are available in Stainless Types 304, 316, and 347 to match piping and tubing of various wall thicknesses in sizes from ⅜" through 12". Send for Bulletin S-310 which gives complete specifications and list prices of the world's most complete line of stainless welding fittings.

WELDING FITTINGS CORP.
NEW CASTLE, PENNSYLVANIA
Formerly Stainless Alloy Division - Pittsburgh Piping and Equipment Co.
World's Largest Manufacturer of Stainless Steel Welding Fittings

Precision STUD BOLTS

MANUFACTURED IN HOUSTON TO YOUR SPECIFICATIONS

ALLOY STEEL

SAE 4140—CHROME MOLY HEAT TREATED TO ASTM SPECIFICATIONS
A-193, GRADE B7—EACH STUD STENCILLED. ---------- (N4 B7)

CHROME MOLY VANADIUM HEAT TREATED TO ASTM SPECIFICATIONS
A-193, GRADE B14—EACH STUD STENCILLED. ---------- (NB 14)

HEXAGON NUTS

AMERICAN STANDARD HEAVY SERIES — COLD PUNCHED
SEMI-FINISHED ASTM A-194—CLASS 2—ASTM A-194
—CLASS 2 H.
THREADED-COARSE THREAD—8 PITCH, 12 PITCH AND WHITWORTH STANDARD.

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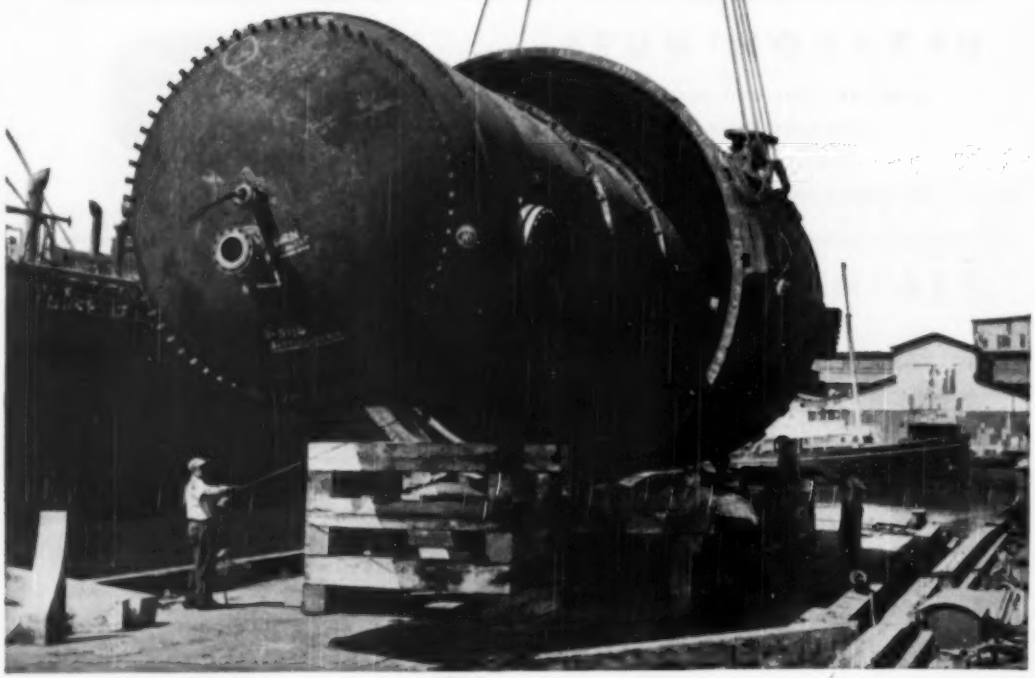
Sun Ship builds superior oil refining, chemical plant, and industrial equipment. But our job doesn't end there—we must deliver the order to the purchaser. Because of our location and our experience in building and handling heavy equipment, transporting large units is no problem. Sun-built products can be shipped by rail, floated, carried as deck loads on sea going vessels, or on barges. And, as shown here, loading big units like this huge fractionating tower so they will travel safely demands special skill and facilities.



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REFINER AUTHORS and Other Personalities

Information, formal and otherwise, about the men who write for PETROLEUM REFINER as well as others prominent in the industry.

LPG Storage Topic Of Spangler Article

C. V. Spangler, in charge of the Pittsburgh office of J. F. Pritchard & Company, is the author of the article, "Storage of LPG Fuels at Low Pressures," beginning on page 86. After being graduated in petroleum engineering from Ohio State University in 1930, he worked until 1940 as geologist and gas transmission engineer for Columbia Gas System. He has been with Pritchard since 1940, starting as field engineer.

Some of the earliest development on gas dehydration by solid adsorption was carried out by Spangler. These techniques are being applied in the field of gas and LPG storage.

Fish Describes Honolulu Refinery

RAY C. FISH, president of Fish Engineering Corporation, describes some of the details of building a refinery in Honolulu, in the article beginning on page 106 in this month's PR. Fish was born at Tiverton, Rhode Island, March 6, 1902. He was graduated from high school and attended college for three years.

He was married to Miss Bess Neal in 1927 and was living in Long Beach, Calif., where he worked in engineering design and construction for J. A. Campbell Engineering Company.

Three years later, 1930, he moved about halfway to Texas, stopping in Denver, Colo. Here he joined Stearns-Roger Manufacturing Company in charge of engineering design and construction of the oil and gas division.

Fish moved to Houston in 1943, as vice president and director in charge of engineering and operation for Tennessee Gas and Transmission Company.

In 1945, he left TGT to organize and head Fish Engineering Corporation. Since that time, he has organized, also serving as president and a director of, Fish Constructors, Inc., Fish Pipeline Construction Corporation, Hydrocarbon Construction Corporation, and Cisco Hydrocarbon Corporation (gasoline plant). He also is vice president and a director of Barnhart Hydrocarbon Corporation (gasoline and carbon black plants, Reagan County, Texas).

Stanolind Plant Design Described

"FULLERTON Gasoline Plant is Formally Opened," the article beginning on page 123 of this month's PETROLEUM REFINER, was contributed by John Mathis Hillsman and Evert W. Kilgren, Stanolind Oil and Gas Company, Tulsa.

John Mathis Hillsman, chemical engineering group leader in the manufacturing department of Stanolind, joined the company in July, 1946, as chemical engineer. In January, 1949, he became group leader. He is a native of Austin, Texas.

His formal education was received at Texas A. & I. College, Kingsville—bachelor of science degree in natural gas engineering, 1939. In 1942, he obtained his master's degree in chemical engineering from the University of Oklahoma.

Evert W. Kilgren is project engineer in Stanolind's manufacturing department and in charge of the department's development section. He joined Stanolind in May, 1946, as chemical engineer, and became project engineer last year.

Kilgren is a native of Manchester, Ind. He received his chemical engineering degree from Michigan State College in 1940, and his master's degree in chem-

Sittig Is Back With Cat Cracking Topic

MARSHALL Sittig (Part I of his extended discussion of "Catalytic Cracking" starts on page 91 of this issue) is not a newcomer in these columns. Previously, in August, 1949, he contributed "Fired Heaters for Petroleum Refining."

Sittig likes to keep abreast of developments in the petroleum industry even though right now he has wandered afield and is engaged in chemical engineering studies for a paper manufacturer. He was first introduced to the petroleum industry by G. F. Olsen of General Petroleum Corporation of California, who hired several Purdue University men for summer work after their sophomore year. A brief period was spent in the General Engineering Department of Standard Oil Company of California after which he did a semester of graduate work and joined a major chemical company. Here he stayed for five years devoting time to the manufacture of raw materials for synthetic rubber. Before his present position, Sittig also was one year in engineering research.

His hobbies are scale-model making but he devotes most of his off-duty hours to his two young daughters.

C. V. SPANGLER | RAY C. FISH | J. M. HILLSMAN | EVERT W. KILGRIN

Behind: An eventful decade...

Ahead: Strength to meet the oil needs of free people

STANDARD OIL COMPANY (NEW JERSEY) REPORTS FOR 1949...

THE 215,000 STOCKHOLDERS of Standard Oil Company (New Jersey) have just been sent the Company's 1949 Annual Report. Some highlights are given here.

The report covers the closing year of an eventful decade—a decade of violent action and change...of war, and war's results, of great shifts in people's living standards, and in their hopes and aims.

It was a decade which put the strength and adaptability of American business to great tests. *And proved that the American kind of business enterprise gets jobs done.*

To the oil business, these last ten years brought demands far beyond any past experience.

Standard Oil Company (New Jersey) carried well its full share of this load. More new supplies of oil were found and developed than ever before. With them came more new processes, more new products, more new jobs and job opportunities. We took in more money, and paid out more—for wages, taxes, dividends, supplies—than in any previous decade in history. And in that ten years almost four times the amount paid in dividends was invested in new facilities—strengthening the business to meet war and post-war needs.

Like all sound American business, Jersey Standard got these results through skill, initiative, teamwork and the productive use of capital. Men who work in the business of their choice—free to think and make decisions—took actions which got results and got them in time.

In reporting for 1949, this Company offers its stockholders not just the report of one business year...With it comes the hopeful assurance of strength and ability to meet the growing oil needs of free people in free lands.

HIGHLIGHTS FROM THE 1949 REPORT:

(for the consolidated companies)

PRODUCTION—957,000 barrels daily total (11% less than 1948)

REFINING—1,287,000 barrels daily total (7% less than 1948)

SALES—1,363,000 barrels daily (slightly less than 1948)

RESEARCH—$21,400,000 spent on scientific projects (6 per cent more than in 1948)

CONSOLIDATED NET EARNINGS—$268,870,000 or $8.91 a share. This compares with $365,605,000 or $12.44 a share in 1948. Total income $2,934,686,000 (12 per cent less than 1948)

PARENT COMPANY NET EARNINGS—(from which shareholders' dividends are paid) $171,707,000 or $5.69 a share. This compares with $155,923,000 or $5.31 a share in 1948.

DIVIDENDS—$4.00 a share plus one share for each 50 shares held.

EMPLOYEE RELATIONS—Again no work interruption due to labor difficulties.

• • •

Copies of the full report will be gladly sent to anyone wishing full details. Write Room 1626, 30 Rockefeller Plaza, New York 20, New York.

STANDARD OIL COMPANY (NEW JERSEY)

AND AFFILIATED COMPANIES

PHILLIP W. WEST | MARSHALL SITTIG | F. A. ZENZ | C. W. WORK

ical engineering at the University of Michigan in 1941.

Esso-LSU Team Contribute Article On Polarography

APPLICATION of Polarography in the Petroleum Industry" by co-authors West and Hale, begins on page 109.

Dr. Cecil H. Hale is connected with the laboratories of Esso Standard Oil Company, Louisiana Division, at Baton Rouge, and Dr. Philip W. West is head of the division of analytical chemistry at Louisiana State University, Baton Rouge.

Dr. West, born in Crookston, Minn., received his elementary education in Minnesota and Idaho. For his bachelor of science and master's degrees he attended the University of North Dakota (1935 and 1936). His Ph.D. in microchemistry was from the Iowa State University in 1939.

West served as assistant chemist for the North Dakota State Geological Survey and was assistant chemist and bacteriologist for the Iowa State Department of Health. After graduating from the State University of Iowa, he went to work for the Economics Laboratory, St. Paul, as research microchemist. He assumed the duties of his present work at LSU in 1940, and has been active in teaching, consulting, and research.

Work in Brazil

In 1946, Dr. West went to Rio de Janeiro to collaborate with Dr. Fritz Feigl on research work on spot test analyses and on the development of new organic reagents. His research activities have centered mainly on spot test methods of analyses and the application of coordination chemistry and organic reagents to inorganic analyses, although he has been active also in developing the use of instrumental techniques for analytical work. He is active in the general development of analytical chemistry, and is originator and chairman of the annual LSU Symposium on Modern Methods of Analytical Chemistry. He has written some 40 articles, including a book, and holds one patent.

Recently, Dr. West was elected to the International Commission on New Reagents and Reactions of the International Union of Pure and Applied Chemistry and he is a Collaborating Editor of Mikrochemie vereinigt mit Microchemica Acta. He will visit leading laboratories during June and July of this year in Europe, and will address the first International Microchemical Congress.

He admits to many vices, including billiards, golf, swimming, and target shooting with small bore rifles.

Photo and biographical data of **Co-Author Hale** were not available.

Home Basement Lab Scene of Research

PARADOXICALLY, outside interests are "in" for Fred Zenz who authored "Screen Skirted Bubble Caps," page 103. In the same home basement laboratory wherein he carried out his masters thesis research, Zenz continues research as a hobby. During the past four years, since receiving his B. S. degree in chemistry from Queens College and M. S. in chemical engineering from New York University, Zenz has been associated with Hydrocarbon Research, Inc., as a chemical engineer devoting the major portion of his time to process development. His earlier experience was with the chemical engineering division of The M. W. Kellogg Company.

During war years, Zenz served as a chemical engineer with the rank of technical sergeant in the special engineer detachment of the army service forces' Manhattan Project employed in the process development department of Kellex Corporation, N. Y., and Carbide and Carbon Chemicals Company, Oak Ridge, Tenn.

A member of the American Chemical Society and the AIChE, Zenz is author of several other chemical engineering articles.

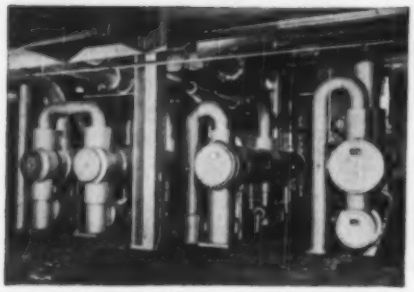
Work Describes Meter

CLAYTON W. Work, of Hagan Corporation, Pittsburgh, contributed the article beginning on page 89, "Unique Characteristics of Ring Balance Flow Meters."

After being graduated from the University of New Hampshire in 1913, Work joined the Westinghouse organization at Pittsburgh. In 1924 he became a field engineer for Hagan in the Pittsburgh area. At present, he is director of publicity, supervising preparation of technical literature for sales and service.

INDUSTRIAL LEADER—For "notable leadership in the field of industrial management," J. Howard Pew, Sun Oil Company director and former president, receives the Vermilye Medal and scroll from Richard T. Nalle, president of the Franklin Institute, Philadelphia. Occasion of the award, made biennially by the institute, was the annual Charles Day Lecture May 17 at which Pew (left, below) was speaker.

five examples of EFFICIENT HEAT TRANSFER EQUIPMENT

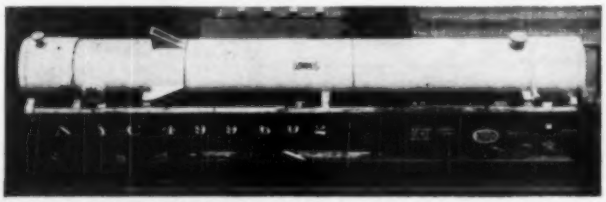


LUMMUS FEED WATER HEATERS and HEAT EXCHANGERS—Left to right, this installation consists of (a) *high pressure feed water heaters:* design pressure of 1,100 psi, tested at 2,200 psi on the tube side—effective surface areas, 935 and 1,355 sq. ft. respectively; (b) *intermediate-pressure heater,* with effective surface area of 1,310 sq. ft.; (c) *low-pressure heater* effective surface 1,750 sq. ft.

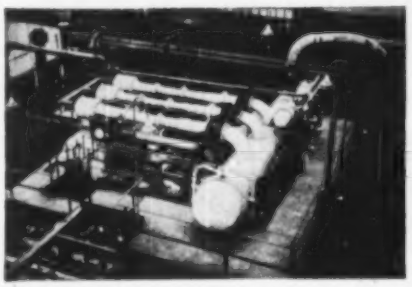
To serve most efficiently in power, refinery, or process plant, heat-transfer equipment must combine enlightened design with superior materials and high-calibre workmanship. Just such a "formula" is realized in each of these five units, representing some of the many types of equipment which Lummus designs and builds to help raise the output and lower the costs of industry.

Lummus, which operates its own manufacturing plant, has an unusually valuable background of experience to apply to your heat exchanger requirements. Throughout the world, Lummus units are operating economically through wide temperature ranges and pressures varying from near-total vacuum to 4,000 psi.

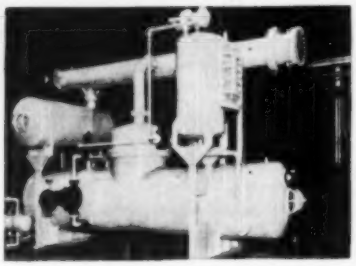
Special-design or standardized, the best formula for efficient heat transfer in your plant is "designed and built by Lummus."



LUMMUS MULTILOK CLOSURES—This catalyst reactor is one of many types of high-pressure equipment with Lummus patented Multilok Closures. These trouble-saving, cost-saving closures are used on feed water heaters and on refinery, chemical, and general industrial high-pressure units with both stationary and floating heads.



LUMMUS STEAM JET REFRIGERATION UNIT—This 350-ton unit, shown before insulation and painting, is installed in the wax de-oiling unit of a large modern refinery. Furnished complete with surface-type condensers and all control equipment, this Lummus unit is arranged so that any single booster or balanced combination of boosters can be operated at reduced tonnage.



LUMMUS EVAPORATORS—Lummus kept this package unit within space limitations by mounting the deaerating feed preheater, the evaporator condenser, the condensate receiver, and the control equipments all on common supports with the evaporator. Evaporators of this type are continuously producing vapors with less than 1.0 p.p.m. solids content when the total solids in the shell liquid is maintained at 3,000 p.p.m.

THE LUMMUS COMPANY
Heat Exchanger Division
385 Madison Avenue, New York 17, N. Y.

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Detroit • Ft. Worth • Houston • Minneapolis • Pittsburgh
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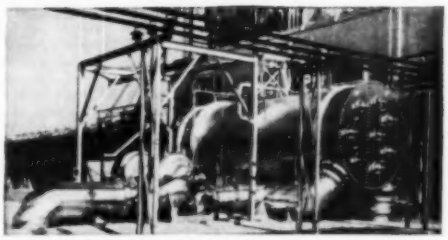


LUMMUS CONDENSERS—This 27,500-square-foot, 2-pass, nondivided waterbox-type surface condenser is a part of a Lummus installation for a southern utility. It was furnished complete with 2-stage, twin-element air ejector and single-stage priming ejector.

LOOK TO LUMMUS for Steam Surface Condensers • Evaporators • Feed Water Heaters • Boiler Blowdown Heat Exchangers Steam Jet Air Ejectors • Steam Jet Refrigeration • Barometric Condensers • Heat Exchangers • Process Condensers • Reboilers Steam Generators (Indirect Fired) • Fuel Oil Heaters • Lubricating Oil Coolers • Pipe Line Coolers • Jacket Water Coolers

HOW TO DO IT

HOW TO—
Make Safety Shield For Welding Helmet

A SHIELD of clear plastic bolted to the chin rest of an electric welder's helmet provides protection during chipping operations and eliminates the time lost in removal of the helmet and substitution of safety goggles. The shield is illustrated in the accompanying photographs.

After the welder has run a bead of metal on the work, the scale, formed during the fusing of the metal, must be chipped away before the next bead is run. Previous to use of the attached plastic shield, the welder had to remove his helmet and slip on a pair of goggles for protection from flying chips. This arrangement was time consuming and inconvenient to the welder, since he must put on and take off the helmet and goggles a number of times each day. In an attempt to correct this situation, some welders wear the goggles pushed up on their forehead under the helmet while welding. This method, however, is not satisfactory because fogging of the lens and the numerous straps around the head become annoying quickly.

During welding, the plastic shield swings up into the helmet in such position that it does not become fogged. After welding, when the helmet is tilted back, the plastic shield is swung down out of the helmet for protection.

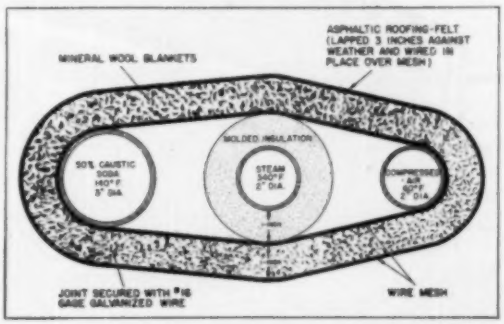
Photographs and material courtesy of "Coin Your Ideas" Committee, Esso Standard Oil Company, Louisiana Division, Baton Rouge.

Photograph at left shows welder using helmet equipped with plastic shield for safety in chipping welds.

HOW—
Insulation Prevents Freezing and Overheating

A SINGLE application of insulation at a chemical plant is serving simultaneously to guard against freezing and prevent overheating in a compressed air line and a caustic soda line, and to control heat loss in a steam line.

The insulation technique used in this type of application is indicated in the cross-sectional drawing. The steam line is insulated to a thickness which permits escape of enough heat to prevent freezing of the caustic soda and the moisture in the compressed air. When the pipe-trio was encased in an overall covering of mineral wool, the process lines were prevented both from freezing and overheating. Further, the steam line was sufficiently insulated by the double layer to prevent heat loss to the atmosphere. Overheating of the process lines during the summer is prevented by this insulation-within-insulation technique.


ASPHALTIC ROOFING-FELT (LAPPED 3 INCHES AGAINST WEATHER AND WIRED IN PLACE OVER MESH)
MINERAL WOOL BLANKETS
MOLDED INSULATION
50% CAUSTIC SODA 140°F 3" DIA.
STEAM 340°F 2" DIA.
COMPRESSED AIR 80°F 3" DIA.
JOINT SECURED WITH #16 GAGE GALVANIZED WIRE
WIRE MESH

After removing extraneous material such as grease and dust from the 300-ft pipes, one-inch molded sectional pipe insulation is applied over the entire surface of the two-inch steam pipe with the sections tightly butted together and securely held in place by metal bands.

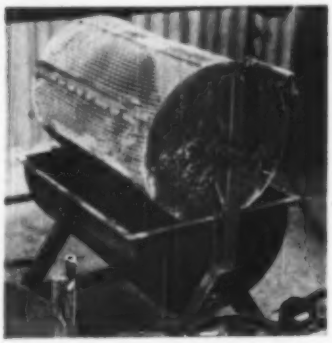
Second, mineral wool blanktes, sandwiched between facings of wire mesh, are cut and shaped around the three pipe lines. The blankets are then wired in place with 16-gauge galvanized wire. Abutting ends and edges of the blankets

are tightly laced together with 16-gauge galvanized wire woven into the mesh coverings. To complete the outdoor installation, asphaltic roofing-felt is wrapped around the 6-inch centers by galvanized wires wrapped around the felt and tightly secured. Drawing and material courtesy of the Industrial Mineral Wool Institute, 441 Lexington Avenue, New York City.

HOW TO—

Make Rotating Basket To Clean Small Parts

THE time required to clean many small parts in refinery shops can be reduced and simplified by a rotating cage-type cleaner. Materials for construction of the cleaner include two circular plates for the ends of the cage, eight metal bars welded to these ends to support hardware cloth covering, and a pin welded to the center of each end to serve as an axle. One panel of the cage is hinged to allow insertion and removal of the parts.

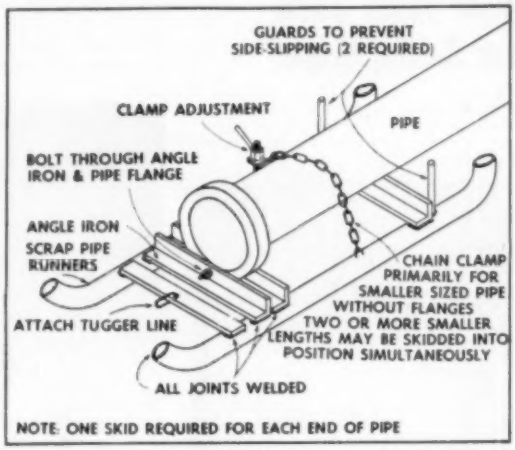


The vat, containing the cleaning solution in which the cage is rotated, is built of sheet metal. It is suspended between angle-iron supports, which are notched for the axle pins. When the cage is loaded with small parts to be cleaned, it is lowered into the vat so that the axle pins are in the lower notches. Then the cage is rotated to clean the parts. After the parts have been cleaned, the cage is raised until it is supported in the upper notches, and the parts are allowed to drain before removal.

HOW—

Special Skids Aid Pipe Handling

GENERALLY, heavy lengths of pipe are handled by motorized equipment; however, in process units, space restrictions often prohibit use of such equipment and other methods must be employed. The specially fabricated skid, illustrated in the drawing, simplifies handling of the pipe and reduce positioning time in those areas where motorized equipment cannot be used. An air tugger is used to pull the skid.


GUARDS TO PREVENT SIDE-SLIPPING (2 REQUIRED)
CLAMP ADJUSTMENT
PIPE
BOLT THROUGH ANGLE IRON & PIPE FLANGE
ANGLE IRON
SCRAP PIPE RUNNERS
CHAIN CLAMP PRIMARILY FOR SMALLER SIZED PIPE WITHOUT FLANGES
TWO OR MORE SMALLER LENGTHS MAY BE SKIDDED INTO POSITION SIMULTANEOUSLY
ATTACH TUGGER LINE
ALL JOINTS WELDED
NOTE: ONE SKID REQUIRED FOR EACH END OF PIPE

The skid is built of pipe with the ends turned up for runners and bridged, or spaced, by lengths of angle iron, which support the pipe. Two skids, one at each end, is required for each length of pipe. As shown in the drawing, the pipe flange is fastened to the front end of the skid by a bolt through the angle iron bridges. At the rear of the skid, a guard is welded to each side of the bridging angle iron to prevent side slipping of the pipe. Since both ends of the runners are turned up, the skid can be moved backward in positioning the pipe.

The chain clamp is intended for use with smaller pipe without flanges, which cannot be bolted to the skid; however, it serves as a safety clamp on larger flanged pipe. The line from the air tugger is attached to a ring provided in the center of the front space bar.

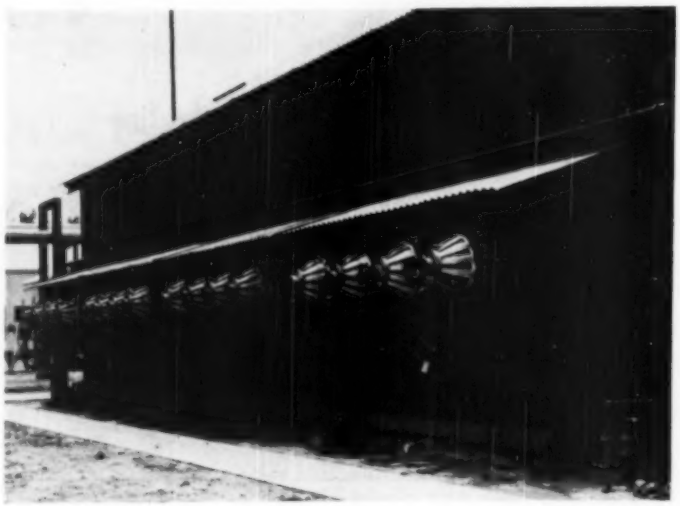
Sketch and material courtesy of "Coin Your Ideas" Committee, Esso Standard Oil Company, Louisiana Division, Baton Rouge.

HOW—

Header Equalizes Fuel Flow to Burners

THE PHOTOGRAPH AT RIGHT illustrates the method employed in a gasoline plant to supply fuel gas to the burners of a rich oil heater.

A double header extends the length of the heater as shown. One side of the header, or loop, serves as the manifold to which the individual burners are connected. The lower side of the loop supplies gas to the burners farthest from the fuel inlet line at the left end and at two intermediate points in the manifold header. Intermediate connections between the headers also serve as supports for the manifold. This method provides equal gas flow to each burner, which simplifies setting and adjusting.



Accurately made to close tolerances
Uniform rib width
Ample lap widths
No cracks on outside corners
No wrinkles on inside corners

No Wrinkles... No Cracks... No Blowouts!

no place for leaks in THIS heat exchanger gasket

TAKE A CLOSE LOOK at the Goetze heat exchanger gasket shown above. Note the absence of cracks on outside corners . . . of wrinkles on inside corners . . . the uniform width of the ribs . . . the generous overlap of the metal jacket.

Attention to such important details is typical of the kind of care that goes into the forming of these custom-made gaskets. It is the secret of their dependable service—why you can count on them to stay on the job indefinitely without leaks or blowouts. And it's the reason they pay off in terms of less down-time and in the savings that result when gaskets *don't* have to be replaced at frequent intervals.

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You can have Goetze heat exchanger gaskets made in any size or shape. Estimates and recommendations will be furnished promptly on request. Write Johns-Manville, Box 290, New York 16, N. Y.

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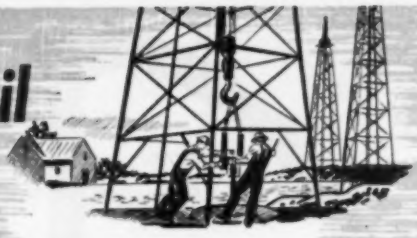
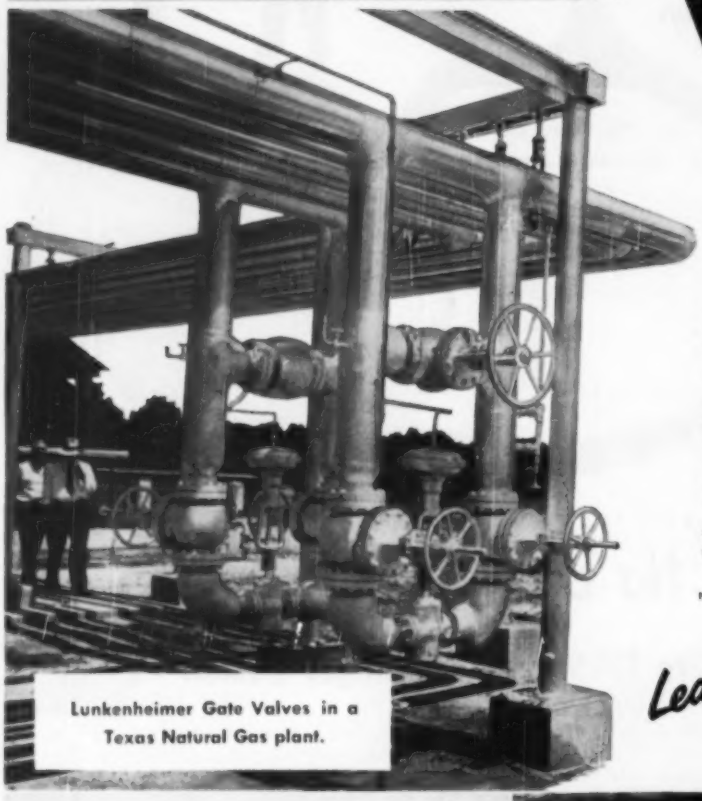


LUNKENHEIMER VALVES



Lunkenheimer Gate Valves in a Texas Natural Gas plant.

• Preferred for dependability and their low cost upkeep, LUNKENHEIMER VALVES are used wherever oil is produced, processed or transported. Available in hundreds of types and patterns . . . globe, gate, angle and check valves for all pressure and temperature requirements . . . all of the highest quality.

LUNKENHEIMER Distributor Service, in every oil producing center, is another reason for the popularity of LUNKENHEIMER VALVES throughout the petroleum industry.

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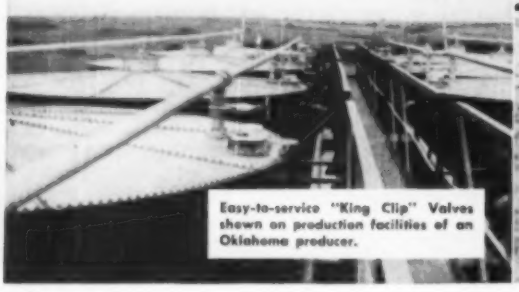

Easy-to-service "King Clip" Valves shown on production facilities of an Oklahoma producer.

Lunkenheimer "King Clip" Valves on a header at production tank battery, Texas refinery.

About EQUIPMENT and SERVICE Suppliers

Mechanical Engineers Named For Turbo-Machinery Division

McCarthy

Greene

Clark Bros. Co., Inc., of Olean, N. Y., has transferred J. E. McCarthy to the staff at Houston where he will be sales engineer with the Turbo-Machinery Division. R. M. Greene succeeds McCarthy as manager of the Turbo-Machinery Technical Service Department.

McCarthy has been an application engineer in the Turbo-Machinery Division of Technical Sales since 1946. He graduated from Cornell University in mechanical engineering.

Greene is a graduate of the school of mechanical engineering of the Cooper Union. He was previously employed in the service department of Foster Wheeler Corporation.

T. F. Killeen Company Named Hammond Iron Agent in N. Y.

Hammond Iron Works, Warren and Bristol, Pa., has announced the appointment of T. F. Killeen Company, Buffalo, N. Y., as its western N. Y. representative.

Hammond Iron fabricates and erects steel storage tanks of cone roof, breather, sphere, spheroid, floating roof and vapor-lift design, and also gas holders, elevated water tanks, steel and alloy plate work.

Electric Machinery Names President and Executives

R. H. Olson, formerly vice president in charge of sales, has been elected president of Electric Machinery Manufacturing Company, Minneapolis. He succeeds W. H. Feldmann who joined Worthington Pump and Machinery Corporation as vice president in charge of sales. Electric Machinery is a subsidiary of Worthington.

A. P. Burris, formerly manager of the New York sales district, was elected vice president in charge of sales for Electric Machinery to succeed Olson. P. L. Shawley, New York office, has been appointed New York district sales manager.

Olson and Burris are both graduates in electrical engineering from the University of Minnesota, joining Electric Machinery in 1919 and 1930 respectively. P. L. Shawley is a graduate of the University of Michigan in electrical engineering and has been with EM since 1927.

Succeeds as Sales Manager Union Carbide and Carbon

E. W. Connolly has been appointed sales manager of the Detroit district of Haynes Stellite Division, Union Carbide and Carbon Corporation.

Connolly

Connolly is a graduate mechanical engineer of the University of Detroit and has been associated with the Haynes Stellite Division for 11 years as sales engineer in the Detroit district. He succeeds R. D. Gunther, whose retirement recently was announced.

Manages Product Development For Ethyl Corporation

William T. Hack has been named manager of the product development department of Ethyl Corporation. A former member of the product development staff, he first joined Ethyl in 1946 and resigned two years later to accept appointment as director of the chemical and rubber division of the National Security Resources Board, Washington, D. C.

Hack

For six years prior to the war Hack was an engineer with Carbide and Carbon Chemical Corporation, South Charleston, W. Va. Later he was with the office of rubber reserve.

A native of New York, Hack was graduated from Princeton in 1935 with a B. S. degree in chemical engineering and attended the graduate school of business administration at Harvard University.

ALCOA Assumes Operations Of American Magnesium

Manufacturing activities of American Magnesium Corporation, the magnesium fabricating subsidiary of Aluminum Company of America (ALCOA), have been assumed by ALCOA. American Magnesium becomes inactive.

Operations of American Magnesium Corporation have been conducted at Cleveland, Ohio, and Buffalo, N. Y., and

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Full of applications, specifications and engineering data that will help solve your grating problems

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WHATEVER your grating problem . . . flooring, catwalks, stair treads, bridge surfacing, sidewalk doors, subway gratings, or any of the hundred and one uses for any industry . . . you'll want this big new Bulletin for complete information on construction details and *all* the advantages of Blaw-Knox Steel Gratings. Ask for Bulletin 2296.

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STEEL VALVES

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PRICED to compete with conventional plug-type valves. Interchangeable with American Standard Steel Wedge Gate Valves. Wrench-Operated; Direct Handwheel-Operated; Worm Gear-Operated; Sizes from 1" to 16". Write for our Catalog No. 600 and Price List. On request, we will be glad to quote on larger sizes above 16".

WEDGEPLUG VALVE CO., INC.
Department "R"
NEW ORLEANS 15, U. S. A.

will be continued there under ALCOA management. Additional megnesium fabricating activities are conducted by ALCOA at several other locations, and these operations will continue.

Inasmuch as ALCOA's sales department has been the sales agent for American Magnesium, there will be no change in selling activities except that ALCOA will invoice directly all shipments of magnesium products.

New District Sales Head

Thomas Whelan, Jr., has been appointed district sales manager for the Houston office of The Patterson Foundry & Machine Company, East Liverpool, Ohio, according to Richard L. Cawood, company president.

Whelan

Whelan, who formerly was associated with C. F. Braun Company, in the design and sale of processing equipment, will maintain headquarters at 2405 San Jacinto Street, Houston 4.

New Sims Disc Pump Valve Promises Greater Advantages

The Sims Pump Valve Company "visual demonstrator," mounted in a Jeep station wagon, is making the rounds of process plants, showing the utility of their products in solving pumping problems. According to the manufacturers, their inclined port rotating disc pump valve cuts down turbulence, pulsation, and valve slam, resulting in overall improvement in reciprocating pump capacities and increased seat disc life. Phil Giraldi, Texas area manager, with headquarters in the M&M Building, Houston, is handling the group demonstrations, which can be arranged on request.

Armstrong Cork Elects President and Officers

C. J. Backstrand has been elected presstrand and H. W. Prentis Jr. chairman of the board, Armstrong Cork Company. Prentis has retired as president after serving 16 years in that capacity. (See page 176, May PR). Kenneth O. Bates,

On the job
throughout the industry!

You find SUPERIOR equipment wherever efficient, modern operation is needed. Why? Because the industry knows that we manufacture refinery and gasoline plant equipment that operates under the toughest conditions.

At SUPERIOR your plans, too, receive the careful attention and skilled workmanship that meets strict code and customer specifications. TRY SUPERIOR!

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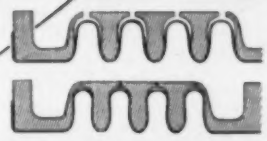
D-F S-E*



*EXPANSION JOINTS

The importance of D-F S-E to you may be measured in dollars. Maintenance costs are reduced to a minimum. Initial cost is amortized over a long life. Case histories show BADGER D-F S-E EXPANSION JOINTS installed in the early thirties are still on the job.

D-F S-E could mean *definite financial savings effected*—actually D-F S-E does mean **Directed-Flexing Self-Equalizing*. Directed-Flexing, an exclusive construction feature in Badger Joints, is a combination of an all-curve corrugated member and correspondingly shaped Self-Equalizing rings which not only limits the movement of each corrugation but also progressively controls each increment of movement over the area of each corrugation. This construction eliminates localized stresses which cause metal fatigue and break-downs.

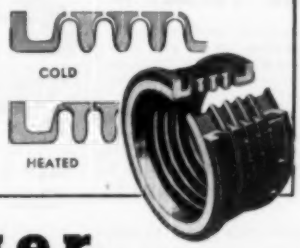
Send today for new 24-page catalog

All-curve flexing guarantees longer life

Badger Joints flex like this . . .

not like this . . .

. . . this stress-free flexing principle exclusive with Badger.



Badger

MANUFACTURING COMPANY

230-260 BENT STREET CAMBRIDGE 41, MASS.

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Rochester STAINLESS STEEL DIAL THERMOMETERS

Extremely sensitive, accurate and durably made of high quality stainless steel, you can depend upon Rochester Dial Thermometers to indicate temperature changes quickly in all types of service. There is no squinting at hard-to-see mercury columns. Big, bold dials permit you to take readings at a glance. You see quickly . . . and can believe what you see!

The new precision bi-metallic element is extremely sensitive, quickly reflecting temperature changes. It is free from indicator vibration and extremes in temperature do not cause distortion. Rugged construction guarantees long life. All exposed parts are stainless steel.

Rochester Dial Thermometers are available in many types, stem lengths and scale ranges. For specifications and prices on these or any other combinations, mail form.

No. 1725—3" dial No. 1750—2" dial No. 1825—6" dial
Stem lengths 2½", 3½", 6", 9", 12", 15", 18", 24"
One piece Sockets—to fit all stem lengths

TEMPERATURE RANGES		
Fahrenheit	*Centigrade*	*Dual Scale*
—50 to 120°F. 30 to 350°F.	—70 to 160°C.	—90 to 130°F.
—70 to 150°F. 0 to 500°F.	—10 to 110°C.	—70 to 56°C.
0 to 200°F. 150 to 750°F.	0 to 150°C.	
0 to 300°F. *200 to 1000°F.	0 to 300°C.	
30 to 240°F.	100 to 400°C.	

*Not recommended for continuous operation above 800°F.

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ROCHESTER MANUFACTURING CO., INC.
38 Rockwood St., Rochester 10, N. Y.

We require..... dial thermometers with temperature range of ..... to .....°; ....." dial; ....." stem.
Please quote.

Name ..... Title .....
Company .....
Address .....
City ..... State .....

re-elected vice president, was designated executive vice president.

Backstrand, with Armstrong since 1921, has served as general manager of the floor division, director, vice president, and first vice president.

Prentis, a former president of the National Association of Manufacturers, joined Armstrong in 1907 and served as the company's first advertising manager and vice president, and was general sales manager of the floor division.

Bates, first a student salesman in the floor division, has also been general manager of the floor division, vice president, and a director.

Fisher Governor Company Manufacturing in England

Fisher Governor Company, Marshalltown, Iowa, has established a new office and plant in London, England, for the manufacture of controllers and regulators. Products marketed by Fisher Governor Company, Ltd., are manufactured by Elliott Brothers (London), Ltd., to the same specifications and standards as that made in the U. S. Interchangeable parts are available from either the Marshalltown or London plant.

Address of the new office and plant is Lewisham, London S. E. 13, England.

Chiksan Names Southern Agent

North and South Carolina territories of Chiksan Company will be covered by Robert S. Hudgins, Jr., newly named representative. The Southern Corporation, Charleston, will continue to represent Chiksan in the pulp and paper industry in these states. R. S. Stover Company has been appointed to the states of Iowa and Nebraska.

Becomes Vice President Manning, Maxwell & Moore

Hamilton Merrill, vice president and director of Manning, Maxwell & Moore, Inc., has been appointed vice president in charge of the Consolidated-Ashcroft-Hancock Division of the company. This division operates manufacturing plants in Bridgeport and Stratford, Conn., Watertown, Mass., Tulsa, and a service and repair plant in Jersey City, N. J.

Merrill

Merrill is a graduate of Massachusetts Institute of Technology and has been with the company 30 years. He was elected a vice president in 1937 and a director in 1949.

Leeds & Northrup Opens New Seattle Headquarters

Leeds & Northrup Company, Philadelphia, has opened a new sales and service office in Seattle, supplementing the San Francisco and Los Angeles offices and the new warehouse at Los Angeles.

The new office is staffed by Stratford B. Biddle, Jr., manager, and Ira F. Omwake, Jr. It services Washington, Oregon, Idaho, and British Columbia.

Engineer Transferred

As devlopment engineer Thomas B. Herndon will transfer to Fort Worth headquarters of The National Supply

SEE
WHAT'S GOING ON

specify
PYREX
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SIGHT GLASSES

PYREX brand sight glasses provide sharp visibility in safety on such equipment as pressure vessels, stills, reaction kettles, ovens, furnaces, evaporators, etc.

PYREX brand glass gives you three exclusive advantages. (1) Thermal endurance under rapid temperature changes. (2) Chemical resistance to all acids except HF. (3) Transparency throughout long service life.

Call your nearest Warehousing Distributor. He stocks PYREX brand sight glasses, gauge glasses, oil cup and lubricator glasses and MACBETH brand flat gauge glasses.

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GLASS WORKS
CORNING, N.Y.
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DRAINAGE
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Clark DUO-STEP Leverage
STEAM TRAPS
• It pays to be curious about the efficiency of the steam traps you are using. Are you getting the value you can and should get in terms of drainage capacity? Or are you paying a premium for the capacity you require?
Clark DUO-STEP is a new idea. It actually gives Clark Steam Traps double the drainage capacity of old-fashioned traps of equal size. And that means double value!
Find out about DUO-STEP today—and save the difference!
STEP 1
cracks the orifice
STEP 2
opens orifice completely
SEND FOR THE STORY ON CLARK DUO-STEP LEVERAGE TODAY!
THE CLARK MANUFACTURING CO. • 1847 East 38th St., Cleveland 14, Ohio

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Scoring on three important points;—scientific design, rugged construction and proper installation, Layne Well Water Systems are generously qualified for the heaviest production jobs on record. Furthermore, once installed, these systems keep right on providing good service for years and years. Records show that upkeep cost, in the majority of installations, is almost non-existent. All installations are exclusively by Layne Associated Companies whose engineers and field crews are widely experienced and thoroughly qualified. All contracts cover the job complete, including the final testing of the unit to assure Layne engineers and the buyer that the System is satisfactory in every way. For further information, catalogs, folders, bulletins etc., address

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SPEED TUBE MAINTENANCE

. . . with the WILSON-DUDGEON *Model 50 Refinery Expander*

YOU CAN BE SURE of fast easy rolling and solid seating of furnace, still and other heavy wall tubes with the specially designed self-feeding and parallel rolling Wilson-Dudgeon Refinery Expander. These expanders are available in multi-roll types, with and without flare rolls, thrust collars and "ironing-out" attachments. There is a Wilson-Dudgeon Expander available for any type of refinery fitting.

Model 50 Refinery Expander

. . . with the WILSON *EP Series Air Motor and Model R Cutter Head*

Wilson EP Series Air Motor with Model R Cutter Head

YOU CAN PUT refinery equipment back "on the line" faster with the Wilson EP Series Air Motor and Model R Cutter Head. Size-for-size, the Wilson "EP" can develop up to 40% more power than ordinary motors. This extra power permits faster cutting action to remove hard heavy deposits in a hurry . . . even from tubes with large diameters. The "R" Cutter Head has renewable cutter pin bearings . . . works at faster cutting speeds . . . is self-feeding and non-tracking.

WRITE TODAY—or see your Wilson representative—for complete information on this time-saving, economical tube maintenance equipment. Ask for Bulletin 380 on Tube Expanders, 47A on Tube Cleaners.

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Strapping designed to last the lifetime of the insulation.
Available types:
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Also Tools for application.

FREE
Handy calculator—one side tells you which strap to use for any given corrosive condition; other side determines length and weight of strap required for any binding operation.

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1936 Hawthorne Ct., Melrose Park, Ill.
(Chicago Suburb)
SM-3

Company, Herndon, who has formerly been with the company in Houston, is an engineering graduate of Rice Institute. He came to National Supply in 1936 after a year with Gulf Pipe Line. Since that time he has served the former firm in technical and sales assignments in the domestic and foreign fields.

Grefco Appointments

Albert E. Bickell has been appointed assistant district sales manager of General Refractories Company's Pittsburgh office. Bickell received his degree in engineering from Penn State in 1936, and was assigned to General Refractories' Buffalo sales office in February, 1937. In 1947 he was transferred to the Philadelphia office.

George L. Peck, who has been with the General Refractories Pittsburgh sales office since 1948, will replace Bickell in the Philadelphia office.

Bird-Archer Canadian Agent

Graver Water Conditioning Company has appointed The Bird-Archer Company Limited as its Canadian representative.

The Bird-Archer organization has modern laboratory facilities at its plant at Cobourg, Ont. The company's main office is at Montreal. The Graver Water Conditioning Company is a division of Graver Tank & Manufacturing Company, Inc.

Chaplin-Fulton's New Address

Formerly at 38 Penn Avenue, Pittsburgh, The Chaplin-Fulton Manufacturing Company is presently located at 5800 Grand Avenue, Neville Island, Pittsburgh 25.

Heads New Houston Office Of Witco Chemical Company

Witco Chemical Company has established an office in the M. & M. Building, Houston, with Allen Craig in charge. Craig has worked with Witco since 1946, following his release from the U. S. Navy. During the war he was in charge of the aviation radar school in Jacksonville, Fla. He was graduated from Lafayette College in 1939, and spent two years with Glidden Company as a production supervisor before joining the Navy.

Craig

Witco's New York offices are located at 295 Madison Avenue.

Chain Belt Sales Engineer

Marshall E. Cusic has been named district sales engineer of Chain Belt Company with headquarters in Pittsburgh. Cusic, a graduate of Purdue University with a degree in mechanical engineering, joined Chain Belt in 1937. He was first assigned to the methods and standards department of the Rex Chain and Transmission Division of which he was later assistant sales manager.

Cochrane Eastern Manager

Ervin J. Bookout has been appointed eastern sales manager by Cochrane Cor-

Federated first for Lead Products

Asarco Sheet Lead... All commercial weights and sizes. Chemical...Tellurium Chemical...Antimonial.

Asarco Lead Pipe... All commercial sizes. Special sizes on request. Chemical...Tellurium Chemical...Antimonial.

Asarco Lead and Lead Lined Valves
... Split Type "Y" and "Angle", Standard "Y", Gate, Check, Hard Lead "Y", Plug and Seat.

Asarco Lead Fittings... Elbows, Crosses, Tees, "Y's", (with plain ends, with flanges on, or for flanging in the field). Chemical and Antimonial.

Asarco Lead Wool... 3/8" rope in 50 lb. waterproof bags.

Asarco Lead Specialties... Extrusions and Castings to specification.

See Federated also for Lead Lined Pipe Lead Lined Fittings, Lead Lined Flanges

Federated Metals Division
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Chemical Refining of Petroleum

By VLADIMIR A. KALICHEVSKY
Research and Development Laboratories, Socony-Vacuum Corpn. Author of "Modern Methods of Refining Lubricating Oils"
and BERT ALLEN STAGNER, Ph.D.
Consulting and Research Chemist; Member, American Institute of Chemical Engineers; Formerly: Supervisor Chemical Research, Union Oil Company of California; Research Fellow, Mellon Institute of Industrial Research

American Chemical Society Monograph, No. 63
Second Edition, Revised and Enlarged

The rapid development of petroleum technology has necessitated a revision of the original volume published in 1933. The newest practice in regard to treatment with sulfuric acid, tetraethyl lead, octane rating, etc., is described in detail. The present emphasis on all phases of this vitally important subject makes this book a particularly timely one, especially since the petroleum problem today is rather one of refining capacity than of crude production. For this reason technical improvements are of the utmost importance for the pressing problems of national defense.

CHAPTERS

Prefaces
Composition of Petroleum
Treatment with Sulfuric Acid
Sulfuric Acid Sludge and Hydrogen Sulfide: Recovery and Manufacture of Sulfuric Acid
Treatment with Alkaline Reagents
Sweetening Operations. Elimination of Elemental Sulfur, and Reduction of Total Sulfur in Light Distillates
Chemical Refining of Petroleum
Refining by Adsorption
Refining with Solvents
Detonation and Antidetonants
Inhibitors of Atmospheric Oxidation of Petroleum Products. Antioxygens
Gums and Cracked Petroleum Products
Deterioration of Lubricating and Similar Oils. Additional Agents
Supplementary List of United States Patents on Petroleum Refining
Appendix. Special Tables
Patent, Author, Subject Indices

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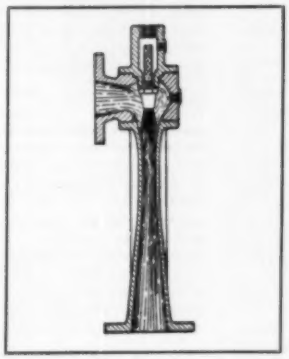
Many stills, dryers, evaporators, crystallizers and other processing vessels are operating at vacua limited by the vapor pressure of the condensate. This means on the average an absolute pressure of about 2.0" Hg. Most owners of such equipment do not realize how practical and economical it is to put a Booster Evactor in the line between the vessel and the condenser and maintain an absolute pressure of 0.5", 0.25" or even lower. The benefits of this higher vacuum in improving quality and capacity are often very substantial.



The steam jet type of vacuum pump has continually gained in favor for high vacuum in industrial process work. The total absence of moving parts is a big advantage and means many years of service, with no maintenance cost. Available in single, two-, three-, four- and five-stage units for vacuum from a few inches up to a small fraction of 1 m.m. Hg. absolute.

Croll-Reynolds have been specializing on this type of equipment for over 30 years, and have made thousands of separate installations. Their engineers have extensive experience in applying it to numerous different processes, and are available for consultation without obligation. Literature is also available on request.

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ALUMINUM made by Patent Scaffolding Co.

ALUMINUM made by Universal Scaffolding Co.

light work is fast work

ALUMINUM made by Safway Steel Products, Inc.

Cutting erection time up to 75% isn't surprising when you realize that scaffolds of Alcoa Aluminum weigh half as much as ordinary units. Even the larger sections can be erected in 20 minutes by 2 men. Quickly moved on the job . . . easily loaded and unloaded from your trucks, they often pay for themselves in savings from a single job.

For a list of manufacturers, write: ALUMINUM COMPANY OF AMERICA, 1424F Gulf Bldg., Pittsburgh 19, Pennsylvania.

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CM HOISTS AND PULLERS are ruggedly constructed to give you years of trouble-free service. Yet they are unusually light... easy to handle because they are constructed of the strongest alloys of steel and aluminum. Equipped with famous Herc-Alloy flexible, welded alloy steel chain.

- Capacities from ¼ to 10 ton.
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GENERAL OFFICES AND FACTORIES: TONAWANDA, N. Y.

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poration, Philadelphia, manufacturers of water conditioning equipment and steam power plant specialties. Bookout has been with Cochrane for many years as sales engineer in the Philadelphia territory, and prior to that in the Cochrane laboratories.

Manages Equipment Sales Of Gilbert & Barker Firm

Frederick E. Neef has been appointed manager of the newly organized industrial equipment sales department of Gilbert & Barker Manufacturing Company, West Springfield, Mass., maker of service station and oil heating equipment. Named as engineer in the department is George W. Plossl with headquarters in Gilbarco's New York office.

Neef

Neef was educated at Columbia University and Brooklyn Polytechnic. Other experience has been with Esso Standard Oil Company as equipment development engineer.

National Aluminate to Use New Cat Cracking Supplier

A new supplier of spray-dried microspheroidal cracking catalyst will soon appear in the oil refinery field according to an announcement last month by President H. A. Kern of National Aluminate Corporation, Chicago. An expansion program for National Aluminate's catalyst division plant at Chicago calls for the installation of complete equipment for producing microspheroidal catalyst by spray drying operations. The addition of this latest type equipment will virtually double the over-all production capacity of the catalyst division. Already underway, the project is anticipated to yield commercial scale production of the spray dried catalyst by the latter part of this year.

At the present time National Aluminate's catalyst division is producing, and will continue to produce, a ground type cracking catalyst for the petroleum industry.

Natural Gas Equipment Has New Office and Warehouse

Increased office space and warehousing facilities have been obtained in new offices of Natural Gas Equipment, Inc., located at 190 East Glenarm Street, Pasadena 2, Calif. The new two-story building contains approximately 7000 square feet and is served by a railroad spur.

Natural Gas has recently acquired representation in California, Oregon, Washington, and Arizona for the products of Valve and Primer Corporation, Chicago.

Refinery Maintenance Opens Permanent Houston Offices

Refinery Maintenance Company, Inc., engineers and constructors of refineries and natural gasoline plants, has established permanent offices in Houston, at 4604 South Main Street. This is an extension of RM's main office in Compton, Calif., "for the purpose of bringing the

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We supply the Teflon stock you need in *any quantity without delay*. Our selection, the most complete in the country, includes many special items. For example, we furnish unoriented sheet Teflon (starting at ¼₆" thickness) in sizes up to 36 x 36"—the largest sheet Teflon offered anywhere.

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You'll find Teflon stock is easily machined or cut into whatever parts you need. So whether you're ready for quantity production or merely wish to evaluate, let us know your requirements. We can help you cut costs in many ways.

For complete information on Teflon and on types and dimensions of Teflon stock available, write for Catalog No. 300.

We also manufacture Teflon parts molded exactly to your specifications.

Teflon Products Division

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in
PETROLEUM PRODUCTS

The sulfur content of oils, waxes and greases is an important measure of the value and quality of the product.

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The combustion method offers a rapid and sure means of determining sulfur in the wide range of percentages and materials encountered in the oil and grease field.

The Dietert-Detroit Sulfur Determinator embodies the correct principles of the combustion method in a simple, rugged and convenient form. Complete analysis can be made in less than five minutes.

Carbon determinations on organic compounds are being made in as little as two minutes with the Dietert-Detroit No. 3003 Carbon Determinator.

This method can be applied to any petroleum product. One example of the usefulness of this method is the analysis of cracking catalyst for carbon content.

Leading oil companies* are taking advantage of these versatile, time-saving determinators. Write to Dept. P-2 for detailed information on how you can apply rapid carbon and sulfur analysis to your problems.

*Two typical users— { THE SHELL OIL COMPANY / THE PURE OIL COMPANY

CONTROL EQUIPMENT
HARRY W. DIETERT COMPANY
9330 ROSELAWN • DETROIT 4, MICH.

company closer to its Mid-Continent and Southwest customers."

In work at the new office is engineering and materials procurement for the large gasoline plant RM will erect for Shell Oil Company at Elk City, Okla.

Dowell Announces Four Promotions in Field Staff

Field staff promotions announced by Dowell Incorporated include W. N.

Smith

Estel

"Woody" Estel, formerly district manager for Dowell in Midland, Texas, named to the Tulsa general office as sales development manager; Ralph H. Smith, district manager in the Houston area, to head activities in the West Texas area through offices in Midland; John S. "Jack" Talbot, previously district sales engineer, to be Houston district manager; E. F. Kelly, Houston development engineer to be district engineer.

Talbot

Estel, a graduate in business from the University of Tulsa, joined Dowell in 1940. He has served as station manager at Grayville, Ill., and district manager at Borger, Texas.

Smith, a petroleum engineering graduate from the University of Texas, joined Dowell in 1944 and became Houston district manager in 1948. He was formerly with the Texas Railroad Commission and Stanolind Oil and Gas Company.

Talbot, a petroleum engineering graduate from the University of Oklahoma, joined Dowell in 1946 at Cleveland.

Kelly joined the Dowell organization in 1946 at Houston.

Babcock & Wilcox Tube To Broaden Fabrication

Plans to enter the field of limited fabrication of seamless and welded tubing, in addition to its primary work of manufacturing such tubing, have been announced by The Babcock & Wilcox Tube Company. Types of fabrication to be handled under the new policy will include bending; end forming such as swaging, upsetting, flaring and expanding; flash-butt-welding for safe-ending and making long length tubing; production of tubing with various cross section shapes and other specialty tube work.

Du Pont Locates in New Offices

The Chicago district office of the petroleum chemicals division of E. I. du Pont de Nemours & Company, Inc., is presently located in new offices in the

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SALES ENGINEER WANTED

Established manufacturer has opening for sales engineer to headquarter in Houston. Should have specialty equipment selling experience to refining and petrochemical industry. Prefer man under forty. Salary and expenses. Give details in letter addressed to Box 172-R c/o Petroleum Refiner, Houston, Texas.

Willoughby Tower, No. 8 South Michigan Boulevard, Chicago 3. The Chicago district laboratory will remain at 1025 South Wabash Avenue, Chicago 25.

Wagner Electric Sets Up New Separate Territory

The southern portion of the sales territory served by the St. Louis electrical division branch of Wagner Electric Corporation has been set up as a separate unit, with headquarters in Memphis and a sales office in New Orleans. A. C. Allen will remain at Memphis as branch manager of the new territory. The remaining territory, with a main branch in St. Louis and a sub-branch in Indianapolis, will be under the direction of J. J. Scheid, who succeeds H. N. Felton as manager of the St. Louis branch. Felton was recently elected vice president in charge of sales of Wagner.

FOR SALE

50% Discount

4—NEW National Transit "ACE" Simplex Steam Pumps, Size 6"x6"x15". Modern close-clearance type with stainless steel trim, for handling of propane, butane, butadiene, casinghead gaso.

NEW Powell Motor-Operated Flanged Gate Valves, series 20, sizes 2" to 12", for pipe-line or plant service; large quantity available.

Phone—Write—Wire

Kinslow Power & Equipment, Inc.

Strode Bldg., 317 So. Boulder TULSA 14, OKLAHOMA

A. O. Smith Corporation Elects

J. M. Floyd, who has been vice president in charge of manufacturing for A. O. Smith Corporation, has been named executive vice president. He will take over general operating supervision of the company under the general direction of the president.

Floyd

Floyd has been in charge of manufacturing since he joined A. O. Smith in 1936. He had previously been works manager for Bendix Aviation Corporation's Bendix Products division.

Floyd is also a member of the board of directors and of the executive committee of A. O. Smith, and is vice president of A. O. Smith Corporation of Texas.

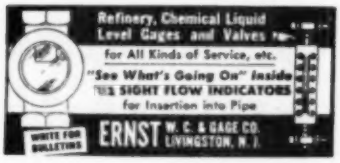
Chicksan Opens Eastern Warehouse Stock

Chiksan Company is establishing a warehouse stock in the Federal Storage Building, 155 Washington Street, Newark 2, N. J., and at the same time is transferring eastern headquarters for Chiksan and Chiksan Export Company from 50 Church Street, New York 7, to the Newark address.

The stock will include Chiksan and Weco products and Okadee loading rack valves.

New Lummus NY Address

The Lummus Company has moved New York offices to 385 Madison Avenue. The company's former location was at 420 Lexington Avenue.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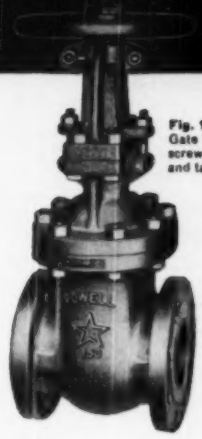

Fig. 1893—Class 150-pound Cast Steel Gate Valve with flanged ends, outside screw rising stem, bolted flanged yoke and tapered solid wedge.

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Fig. 1793 — Large 125-pound Iron Body Bronze Mounted Gate Valve. Flanged ends, bolted flanged yoke, outside screw rising stem and tapered solid wedge. Also available in All Iron.

Fig. 375 — 200-pound Bronze Gate Valve with screwed ends, inside screw rising stem, union bonnet and renewable wear-resisting "Powellium" nickel-bronze disc.

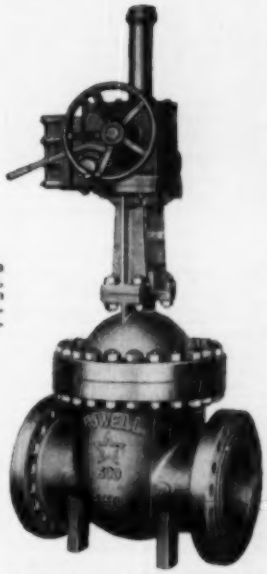

Fig. 6079 M.O.—Class 600-pound Cast Steel Gate Valve for Pipe Line Service. Has flanged ends and bolted flanged bonnet. Motor operated. Also available in Classes 150, 300, and 400 pounds.

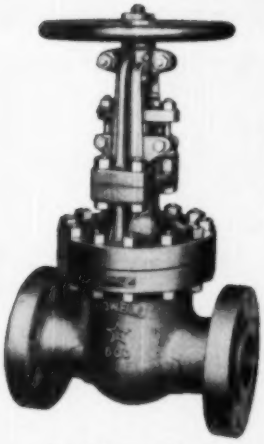

Fig. 6003—Class 600-pound Cast Steel Gate Valve with flanged ends, outside screw rising stem, bolted flanged yoke, tapered solid wedge.

The Complete Powell Line includes Globe, Angle, "Y", Gate, Check, Non-return, Relief and Flush Bottom Tank Valves in Bronze, Iron, Steel and a wide range of Corrosion-resistant metals and alloys.

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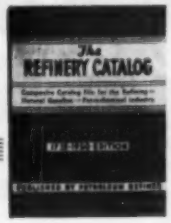

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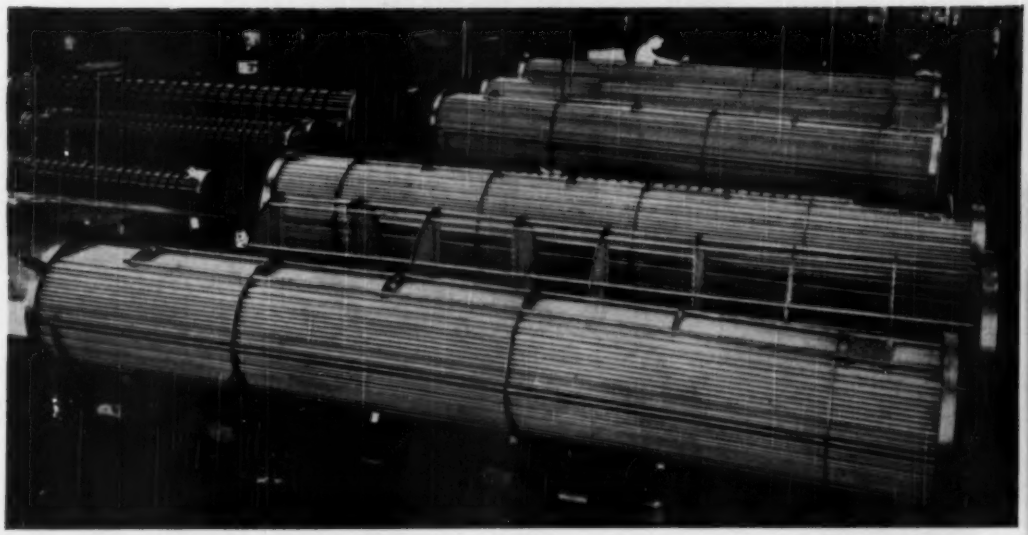

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In 1944 there were . . . *215*
In 1948 there were . . . *500*

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652

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